

Microcontroller Based Bidirectional Digital Visitor Counter

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1 Abstract

This paper presents the design and construction of a digital bidirectional visitor counter (DBVC). The DBVC is a reliable circuit that takes over the task of counting number of persons / visitors in the room very accurately and beeps a warning alarm when the number of visitors exceeds the capacity limit of the auditorium/hall. When somebody enters the room then the counter is incremented by one (+1) and when any one leaves the room then the counter is decremented by one (-1). The total number of persons inside the room is also displayed on the LCD (Liquid Crystal Display).

The microcontroller is used for detecting an entry or exit action and computing the figures (addition and subtraction) to acquire accurate results. It receives the signals from the sensors, and this signal is operated under the control of embedded programming code which is stored in ROM of the microcontroller. The microcontroller continuously monitors the Infrared Receivers. When any object pass through the IR Receiver's then the IR Rays falling on the receivers are obstructed.

The obstruction occurs under two circumstances, either you obstruct sensor 1 (i.e. outside the building) before sensor 2 (i.e. which is inside the building) this shows that you are entering the building or you do it the other way round, which is obstructing sensor 2 before sensor 1 to indicates an exit movement. This obstruction is sensed by the Microcontroller, computed and displayed by a 16x2 LCD screen.

2 Introduction

Visitor counting is simply a measurement of the visitor traffic entering and exiting conference rooms, malls, sports venues, etc. With the increase in standard of living, there is a sense of urgency for developing circuits that would ease the complexity of life.

Over the years, the usage of Visitor counters has become very positive in terms of monitoring crowd behavior at a particular place. It began with a mechanical tally counter which was introduced to replace the use of tally stick. A tally (or tally stick) was an ancient memory aid device used to record and document numbers, quantities, or even messages. Historical reference is made by Pliny the Elder (AD 23–79) about the best wood to use for tallies, and by Marco Polo (1254–1324) who mentions the use of the tally in China. Tallies have been used for numerous purposes such as messaging and scheduling, and especially in people counting, financial and legal transactions, to the point of being accuracy.

The substitute of the tally stick was the mechanical tally counter, it is a device used to incrementally count something, typically passing. One of the most common things tally counters are used for is counting people, animals, or things that are quickly entering and existing a location.

As times went on, an electronic tally counter was introduced which used an LCD screen to display the count, and a push button to advance the count. Some also have a button to decrement the count in case of a miscount. Now, due to technology advancement, various type of people counter has been introduced to automatically count the number of people entering and exiting a building at a particular time. Some of these are laser beam, thermal imaging, video camera and the infra-red sensor. All these sensors play their role respectively as visitor detector. These devices are very reliable and accurate in terms of performance as compared to the mechanical tally counter.

In the past years, several well established institutions (libraries, community centers, auditorium, etc.) across the globe have encountered various incidents related to traffic monitoring. It has been a necessity to monitor the visitors to carry out the human traffic management task and tourist flow estimate to vindicate accurate result for the organizational marketing and statistical research. This eventually indicates the patronage rate of goods and services by consumers. Therefore, we deem it appropriate to identify these problems encountered by our various organizations and find solutions to them by designing a digital bidirectional visitor counter (DBVC).

The primary method for counting the visitors involves hiring human auditors to stand and number of visitors who enter or pass by a certain location.

manually tally the The human auditing application or the human-based data collection was unreliable and came at great cost. For instance, in situations where a large number of visitors entering and exiting buildings such as conference rooms, law courts, libraries, malls and sports venues, going for human auditors to manually tally the number of visitors may result in inaccurate data collection. For this reason, many organizations have tried to find solutions to mitigate the inaccurate traffic monitoring issues. It is our intention

to design and construct this digital bidirectional visitor counter (DBVC) with maximum efficiency and make it very feasible for anyone who wants to design and construct the prototype. Building this circuit will provide information to management on the volume and flow of people in a building.

Our main objective in this paper includes designing and constructing a visitor counter which will make a controller based model to count and compute the number of visitors in a building at a particular time. It is also our objective that this controller base model beeps a warning alarm when the capacity of the building is exceeded.

The significance of the design and construction in this paper is enshrined in the fact that it provides the assurance of the health and safety of the occupants in a building at all time, since the visitors are guaranteed of traffic decongestion. It also provides accurate data for various research and analytical purposes as it generates the hourly, daily, monthly, and yearly report. The device helps to reduce pressure on building facilities by prompting the security, when the capacity of the building is exceeded. It goes a long way to assist rescue team or security services to come up with strategic procedure in dealing with emergency issues like people trapped in a structure as a result of hijacks and collapsed building which occurred recently at the West End Gate Mall in Kenya and Melcom in Ghana respectively.

It is the usual norm that the design and construction of every device comes with some limitations and ours cannot be an exception. In this paper, our device might count more than two people as one when they interrupt the infrared beam at the same time in a linear direction. For this reason, the device must be installed at a narrow entrance/exit where one person enters at a time. Another limitation can be linked to the inability of sensor in the device to differentiate between human being and objects interrupting the IR signal. Finally, the device will fail to function in case of any power interruption, which might lead to a miscount or provide inaccurate data when power is restored.

3 Methodology

This section introduces the methodology involved in the design and construction of the Digital Bidirectional Visitor Counter (DBVC). Using the Takoradi Polytechnic Library crowd management situation as a case study, it was realized that the library's capacity often gets exceeded during its peak usage period (examination period) and therefore makes the environment uncomfortable for learning. This problem was studied by visually observing students reaction anytime the library's capacity was exceeded. Another study was made on the Melcom tragedy incident, whereby the exact number of people trapped in the collapse building was unknown. False information about the number of people trapped was given to the rescue team at their arrival, but they ended up rescuing more survivors than the expected number revealed to them. This means a

lot of people could have died if the rescue team relied on the information given to them.

This chapter covers all parts of a DBVC from the system overview to the individual components required to assemble the visitor counter to provide effective crowd management as in monitoring and controlling. The microcontroller based visitor counter is designed to respond to the flaws in the operations of the existing counters. The design in its sense has four (4) main sections and circuits as shown in Figure 1. These include detection section (IR sensor circuitry), microcontroller section, alerting section (LCD and Buzzer) and power supply circuit.

3.1 Microcontroller Section

The microcontroller section consists of the PIC16F877A Microcontroller which is a powerful (200 nanosecond instruction execution) easy-to-program (only 35 single word instructions) CMOS FLASH-based 8-bit microcontroller packs Microchip's powerful PIC architecture into a 40-pin package and is upwards compatible with the PIC12CXXX and PIC16C7X devices. The PIC16F877A features 256 bytes of EEPROM data memory, self-programming, an ICD, 2 Comparators, 8 channels of 10-bit Analog-to-Digital (A/D) converter.

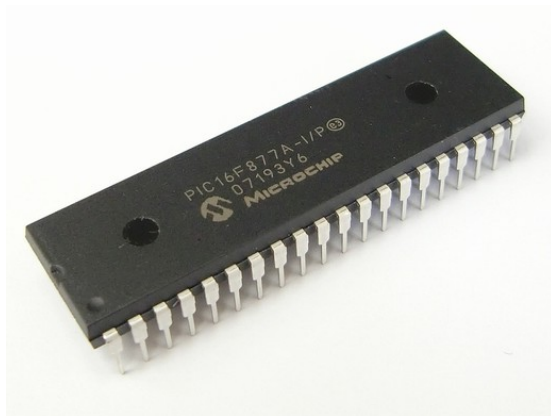
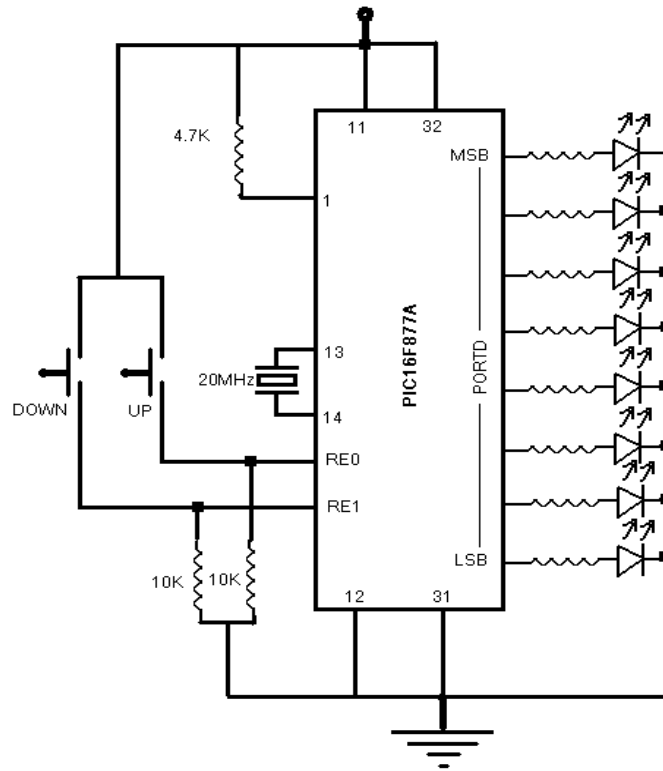


Figure 1: Pictorial view of a PIC16F877A microcontroller

3.2 Circuit Diagram

I use LED instead of LCD monitor and push button instead of IR sensors.

8-BIT UP/DOWN COUNTER CONTROLLED BY PUSH BUTTON



3.3 Program(for HI-TECH C compiler)

```
#include <pic.h>
#define _XTAL_FREQ 20e6
__CONFIG(0x3F3A);
unsigned char count=0;
main()
{
    ADCON1=0b00001111;    //to make PORTE as digital I/O pins.
    TRISD=0;
    TRISE0=1;
    TRISE1=1;
```

```

while(1)
{
  if (RE0==1)
  {
    if (count < 255){count++;}
    __delay_ms(50);
    while (RE0==1);
    __delay_ms(50);
  }

  if (RE1==1)
  {
    if (count > 0){count--;}
    __delay_ms(50);
    while (RE1==1);
    __delay_ms(50);
  }
  PORTD=count;
}

```

4 Results and Discussion

The actual project was very difficult to implement. So for simplicity I used push button instead of IR sensors and also used LED for display the results instead using a LCD monitor. For entering as a person I use the 1st push button and existing of a person I use 2nd push button. The result is displayed in binary form by LEDs.

References

[1] blog.vinu.co.in