DEVELOPMENT OF A BUS PASSENGER MONITORING DEVICE

C. O. Alendghena and C. Nwala
Department of Electrical and Computer Engineering,
Federal University of Technology, Minna, Nigeria.
GSM No. 08035015984 Email : alenca2@yahoo.com

Abstract:
A careful study of revenue system in some commercial passenger bus schemes, show that the manner in which tickets are sold, collected and destroyed gives room for many lapses. This introduces shortfall in the income generated because the only proof of service rendered to its customers is destroyed at the entrance of the buses. In engineering, this can be considered as an open loop system, which is a control system that has no feedback. This design counts the actual number of passengers alighting from the bus using a bottom-up approach. The design employs the use of transistor counters whose output is connected to the trigger of a display driver, which is, in turn, connected to a seven-segment display. The circuit was constructed and found to work in accordance to the design specifications.

KEY WORDS: decade counter, seven segment display, triggering, debouncer.

Introduction.

Electronics has come a long way over the past century to add to the development of man. In virtually every area of human endeavor electronics has found its place; reducing tedious work practices, saving working time, increasing efficiency with productivity and accomplishing jobs that would otherwise have taken a life time to completely execute.

In this design, the actual number of passengers that use the bus over a specified period of time is gotten. This is to aid its accounting department in getting the actual figure to serve as a reference for the income generated over a set period.

The electronic circuit primarily counts the number of passengers that use the bus, thus compelling personnel's response to revenue collection to balance income with the number of passengers that use the bus. By this, even the normal collection of money by the driver assistance can be employed. The set of methods and principles used in achieving the circuit can be referred to as the bottom-up methodology. The actual state of entrance, which coincides with the exit of the bus was noted. Counting is to be done in one direction, in order to eliminate double counting; thus, two-switch system was employed. The switches are connected in such way that a pulse is sent only if they are triggered in one direction. This results in the introduction of a transistor for its switching ability. Even in triggering the transistor it was observed that there would be a time delay in the triggering of the switches, hence, the introduction of a resistor/capacitor time delay combination. The output of the transistor is now connected to the trigger of a display driver which, in turn, is connected to a seven-segment display.

This method of counting finds its usefulness everywhere the entry and exit are limited to one point, which could be seen in hotel rooms, elevators, executive board rooms, among others.

The realization of the main objectives of counting the number of passengers received in business over a period of time by a commercial bus scheme is illustrated in Figure 1.

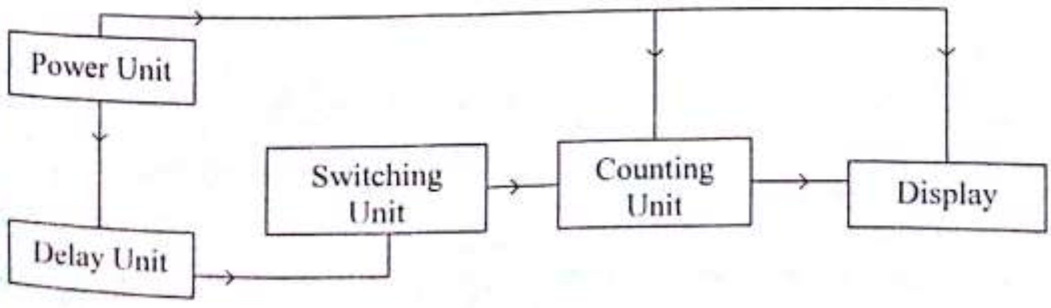

Fig 1: Modular representation of the bus passenger system

The power unit consists of a car battery, a voltage regulator, and a power delay circuit. A normal bus battery is 24V with current rating of 110 to 200 amperes. This is far much more than is needed for a simple electronic circuit, hence, the need to reduce the incoming power according to the circuit requirements.

The battery is connected to a voltage regulator as shown in figure 2.

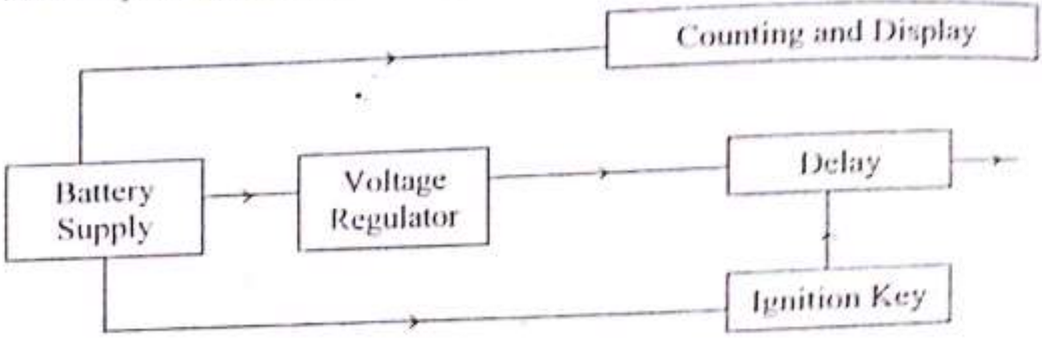

Fig 2 : Practical Application of Power Unit in the

The voltage regulator produces the coinstant 5 V required to power the TTL display unit. From this point supply is connected to two different points. The first is to the counting and displaying unit. This is to ensure that the data stored in the counter is not lost when that part of the circuit is turned off. The other goes to a delay circuit that has its trigger as the ignition key, the output of which is connected to the main circuit.

Delay Unit

The delay unit comprises of the following, a push button (normally closed) switch, a 555 timer and combinational simple circuit of a capacitor-resistor as shown in figure 3.

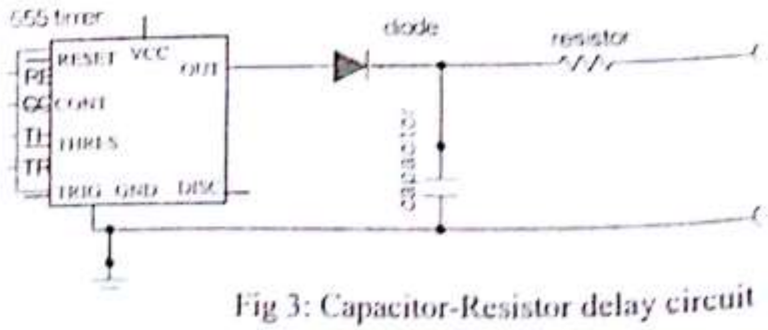

Fig 3: Capacitor-Resistor delay circuit

The diode is placed in between the 555 timer and the capacitor for two reasons.

- to act as a protective device for the 555 timer and
- to force the capacitor to discharge in one direction, offering very high resistance in the other direction.

Switching Unit

This unit is the centre of the whole circuit, which is called the decision section. Here it is expected to differentiate between a pulse that should be counted and those that should not. By varying the time of each pulse reaching the AND gate, one can discriminate between the input A and B being high or alternating. This variation was achieved through the use of a transistor which acts as a switch. Working in a common emitter mode with input current (base current) coming from the delay circuit and a shape pulse coming from a push button switch to the collector terminal. It could be seen in figure 4 that, the duration of the pulse that comes from the switch S is much shorter than that which comes from the input of the base terminal. In this way, once the 200μF capacitor is charged it begins to discharge gradually through the transistor to the ground. But if during that discharge a pulse comes from the collector, only then will an output be seen at V_{out}. This is to say that if the switch S is closed first, the pulse comes into the collector and goes to the ground because there is no base current to complete the switching process.

Whereas if the switch in the 555 timer is triggered first, then, it charges the delay circuit that would hold enough charge to complete the switch at the arrival of the collector current.

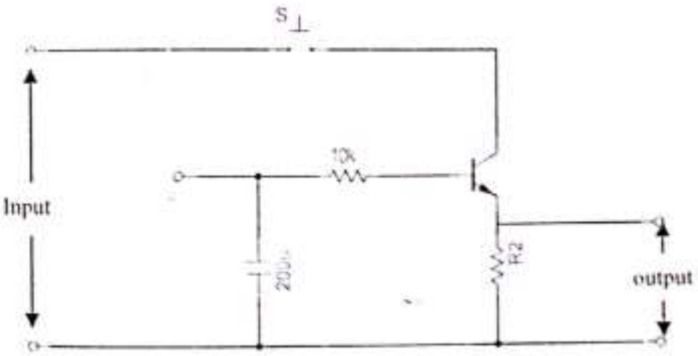

Fig 4: A Transistor Switch

The resistor R_2 = 330 ohms acts as a pull down resistor dropping the internal voltage of the counter to less than 0.8 from its original value of 1.6V.

Counting Unit

It is expected to keep track of event, in this case, every pulse that comes out of V_{out} of the transistor. To achieve this two counters were employed, primarily to give a two digit count (up to 99). The 74192 up/down decade counter was This belongs to the family of 74LS (low power schottky) that uses TTL (Transistor-Transistor logic) circuitry, which is fast but requires more power than other members of the family[3].

This is a synchronous counter that has two separate clock inputs for counting up and down. The count increases as the up clock input becomes high (on the raising-edge). The count decreases as the down clock input becomes high (on the raising-edge). In both cases the other clock input should be high. The IC can be seen in figure 5

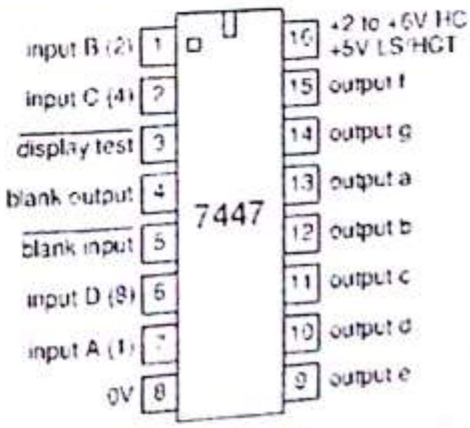

Fig 5 : Counter pin layout

Display Unit

This gives a visual image of the present count of the 74192 IC, making it to be easily understood by man. The type of display used is a seven-segment display with decoder driver. The decoder driver chosen for this job is the 74LS274 due to unavailability of the second decoder that is needed for a full two,digit display.

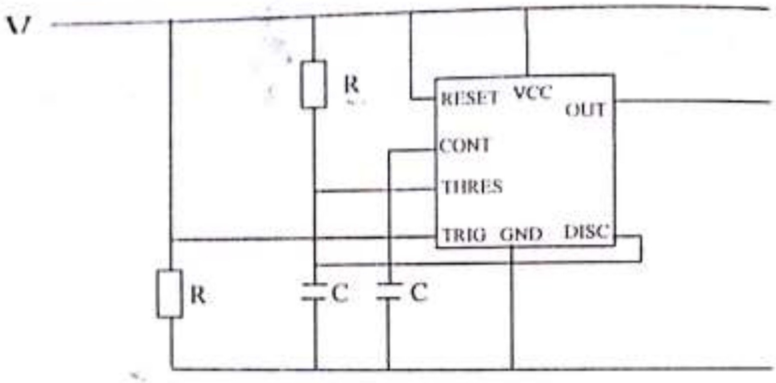

Fig 6: Capacitor-Resistor delay design circuit

Design Calculation

Across the 555 timer,

Total external resistance = 10k + 10k

= 20k

Voltage across the resistor = 5V

Therefore, current flow to the 555 timer, $I_1 = V/R$

$I_1 = 5/20k = 25mA$.

The current drop across the pull down resistor of 330 ohm, for a voltage drop of 1.6V,

$I_2 = 1.6/330 = 4.848mA$

The current drop across one of the resistor connecting the output of the decoder to the anode of seven segment display receiving a voltage drop of 5V is

$I_3 = 5/330 = 0.015A$.

Since there are seven connected in such a manner for each of the two decoder (meaning R x 14)

$I_{31} = I_3 \times 14$

$= 0.015 \times 14$

$= 0.212A$

$I_{3T} = 212mA$.

Being that the TTL IC family requires few milli-watt to operate, current through the IC is negligible. Hence, total current within the circuit I_T will be given as:

$I_T = 212m + 4.8m + 25m$

$= 241.8mA$.

With the knowledge of the expected circuit current consumption, the filter capacitor to be used is calculated using the formula given below:

$$C = \frac{I_{fs}}{4\sqrt{3}FV_{pp}}$$

$$= 241.8m/\left(4\sqrt{3}x50x5x0.07\right)$$

$$= 1.994\,x\,10^{-3}\,\mu F$$

$= 241.8m / (4\sqrt{3} \times 50 \times 5 \times 0.07)$

$= 1.994 \times 10^{-3}\mu F$.

For which 2200μF could be used.

Recap:

1. The choice of 10k resistor between Pin 7 and source for the 555 along side the 98.7 x 10^{-3} F was to achieve a delay of one second in the conducting part:
   T = 1.1 x 10k x 98.7 x 10^{-3}
   = 1.0857 sec.
2. The delay made by the resistor-capacitor circuit will offer a delay of T = R x C. where, R = 20kohms and C = 1 x 10^{-4} F
   Therefore, T = 20k x 10^{-4} = 2 seconds.

Performance Evaluation

The method of testing used for this work is the simple use of a multimeter to measure voltage and resistance at some points, alongside observing the behavior of each component to see if it matches the function to which it was put together. The following tests were carried out:

1. After plugging the 74192 IC (the decade counter) and the corresponding driver display test input (Pin 3) was given low (0) and all the seven segments of the display came on. Showing all the drivers are in good working conditions.
2. The counting sequence was observed to step perfectly. This was expected because a de-bouncer was used.
3. The time delay for each clocking was manually taken and it showed that the value of the resistor/ capacitor was more than needed for a two second delay. Hence, a downward review of these values.

Other parameters tested and their results are stated in Table 4.1

Table 2.0 Test result

Type of test	Result	Remark
Output of the 555 timer IC	4.22 volts	Good
Power unit output	5.02 volts	Good
Counter input voltage	1.7 volts	Good

Conclusion

The various tests carried out and the results obtained demonstrate that the bus passenger monitoring device is perfect for the immediate purpose of counting persons, who actually shuttle with the school bus. Initially, the idea that counting the number of passengers that enter the bus can only be achieved with complex circuit due to all it constraints have been proven wrong. The bus passengers monitoring device is thus a simple but effective electronic tool that can be used to detect fraud and help for better bus managements.

The maximum count is 99 passengers; which can be increased to infinity.

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APPENDIX

Fig 7.

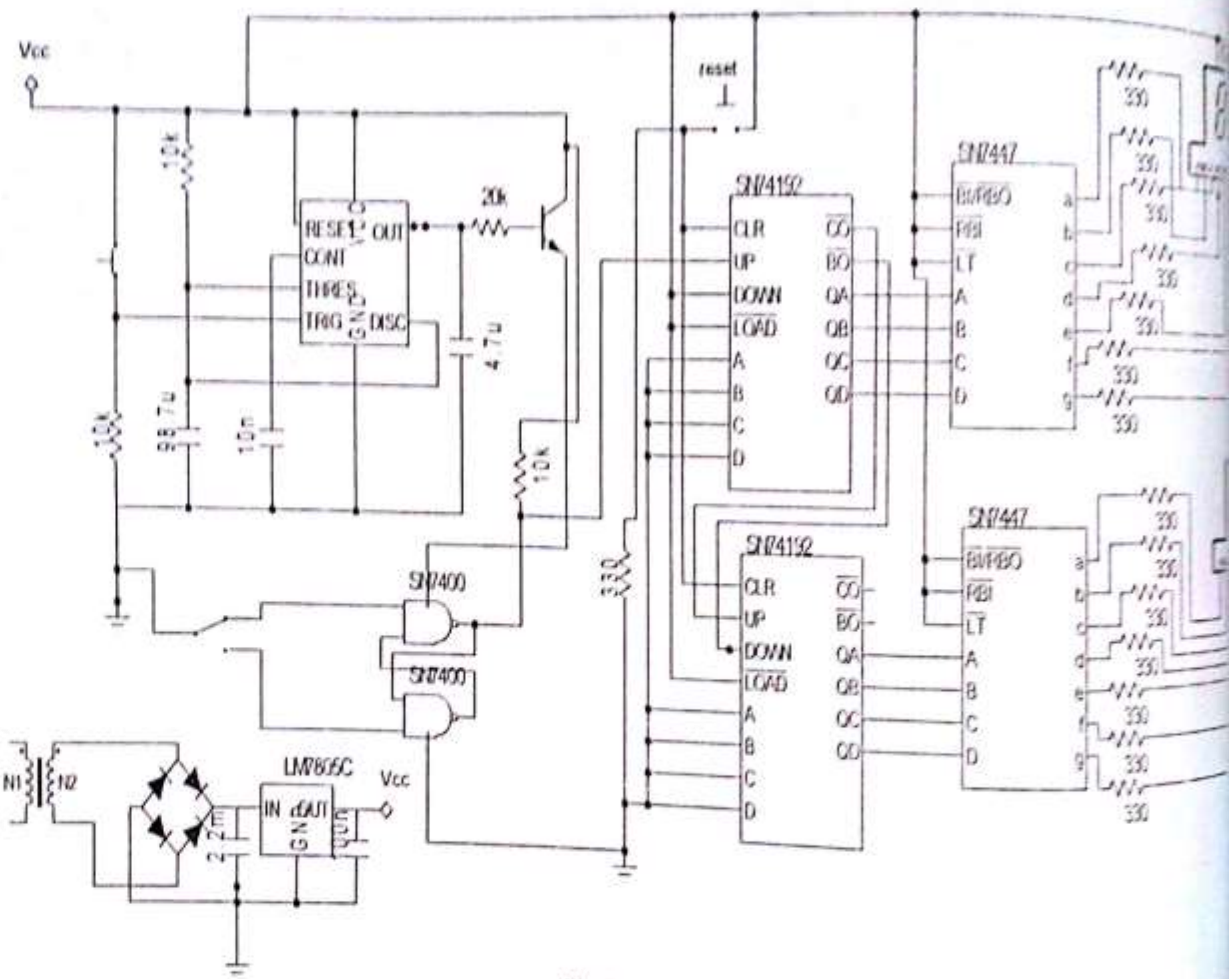

Fig 7. Complete circuit diagram of the Bus passenger-monitoring