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The Design of an Advanced Bus System

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Abstract: For the increasing accident rates involving school buses, this paper has designed an advanced school bus system which includes an overload detection system using infrared emission transmitters and receivers. This will give the exact number of students in the bus to avoid accommodating students beyond the predetermined capacity of the bus. Pressure sensors and proximity sensors or presence sensors are also provided. Pressure sensors are placed at the footboards of the bus and proximity sensors near the doors of the bus to avoid unnecessary accidents.

Keywords: infrared, overload, pressure sensors, school bus.

I. INTRODUCTION

Overload of school buses happens daily, to reduce the cost of transportation and the number of bus trips. Though overloading has been prohibited by law, it still takes place, resulting in frequent accidents involving children. Similarly negligence is major cause in accidents involving school buses. Movements of buses while students are still standing on the footboards have resulted in serious injuries or death during minor accidents. Negligence to ensure that the student has moved away from the vehicle door to a safe distance before starting the bus has also resulted in many accidents. This paper has designed a system that is capable of eradicating these problems to a limit.

II. COMPONENTS REQUIRED

1. IR Transmitter and Receiver

IR transmitter and receiver are used to control any device wirelessly, for example in T.V remotes TSOP1738is generally used as the IR receiver, which senses modulated IR pulses and convert them into electrical signal. IR transmitters generate IR rays of the required frequency specification. The IR receiver senses the IR rays and modulates these pulses into electrical signals.

2. IR Proximity Sensor

Proximity sensors are used to detect the presence of nearby objects without any physical contact. They emit an electromagnetic field or a beam of electromagnetic radiation (e.g. infrared), and looks for changes in the field or return signal. The object being sensed is referred to as the proximity sensor's target. The maximum distance that a proximity sensor can detect is defined as "nominal range". Some sensors can adjustment their nominal range or have the means to report a graduated detection distance. Fig 2.1 shows an IR proximity sensor. They have a high reliability and long functional life because of the absence of mechanical parts and the lack of physical contact between sensor and the sensed object. They are commonly used in smartphones to detect accidental touch screen taps while attending a call. They are also widely used in the parking system. They are mounted on the car bumpers that sense distance to nearby cars while parking.

3. Microcontroller – AT89C51

The AT89C51 microcontroller is a low-power, high-performance CMOS 8-bit microcomputer with 4K bytes of Flash programmable and erasable read only memory (PEROM). This device is manufactured using Atmel's high-density non-volatile memory technology. The on-chip Flash allows the program memory to be reprogrammed in-system or by a conventional nonvolatile memory programmer. By combining a versatile 8-bit CPU with Flash on a monolithic chip, the Atmel AT89C51 will act as a powerful microcomputer which provides a highly-flexible and cost-effective solution to many embedded control applications.

4. Segment Display

Seven segment displays or seven segment indicator is an electronic display device used for displaying decimal numbers. It is a good alternative compared to the much more complex dot matrix displays. It is widely used in digital clocks, electronic meters, calculators and other electronic devices that display numerical information. A seven segment display consists of seven LEDs arranged in a rectangular fashion. Each of these seven LEDs is called a segment because when illuminated segment forms a part of the numerical digit to be displayed.

5. Piezo Buzzer

Fig 1: IR proximity sensor

Fig 2: piezo buzzer

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A Piezo buzzer is an audio signaling device which produces sound based on the reverse of the piezoelectric effect. Fig 5.1 shows a piezo buzzer. It consists of piezo crystals placed between two conductors and as soon as a potential is applied across these crystals, they will push on one conductor and pull on the other. This push and pull action will result in a sound wave. Most buzzer produce sound wave in the range of 2 to 4 kHz.

III. STRUCTURE OF PROTOTYPE SYSTEM

This proposed system is mainly intended for reducing the accidents involving students when travelling in school buses. The proposed system can be divided into three different systems

1. Overload detection system
2. Pressure detection system
3. Proximity detection system

The circuit and working of the three systems included in the proposed bus system are detailed below in sections III, IV and V respectively.

IV. OVERLOAD DETECTION SYSTEM

IR emission transmitters and receivers are used to count the number of students entering and leaving the bus. This gives the accurate number of students inside the bus so that overloading can
be detected [1]. This system will help reduce deaths and injuries in accidents involving buses with excessive passengers.

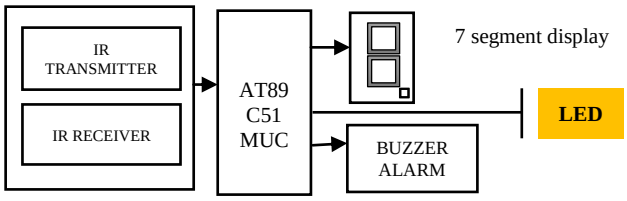

Fig 3: Block diagram of overload detection system

IR sensors are placed at the doors of the bus. As a student enters the bus, the IR ray will be interrupted [1]. Each time the IR ray is interrupted the count will go up by one. The c program for counting the number of students will give the accurate number of students that have entered the bus. At any time if the number of students inside the bus happens to be more than the allocated number of seats on a bus, a buzzer will go off and the LED indicating overload will light up on the LED panel board as an indication that the bus is overloaded. As soon as the extra number of students is un mounted from the bus through the exit door, the buzzer will stop ringing. Fig 4.1 represents the proposed block diagram for the overload detection system.

V. PRESSURE DETECTION SYSTEM

Negligence in school buses is also a major cause of accidents.
In this system, pressure sensors are placed on the footboards of the bus. This is done to mainly avoid children from standing on the footboards of the bus while the bus is moving resulting in serious injuries or even death during an accident.

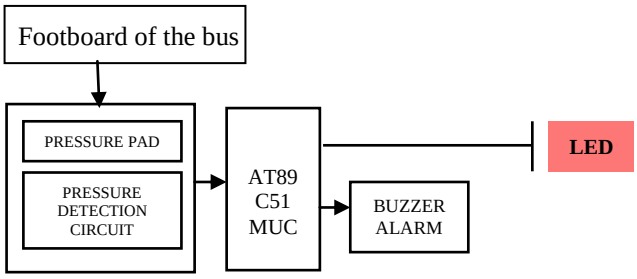

Fig 4: Block diagram of pressure detection system

The pressure sensor circuit comprising of a pressure pad is placed on the footboards of the bus. This sensor is also connected to the buzzer to alert the driver in case a student is standing on the footboard when the bus is about to start moving. Fig 5.1 shows the block diagram of the proposed pressure detection system to be placed on the footboards of the bus. In the scenario of a student standing on the footboard, the buzzer alarm will give a warning bell and the LED on the panel board corresponding to the pressure detection circuit will light up.

VI. PROXIMITY DETECTION SYSTEM

There have been numerous accident cases where children have been run over by their school bus drivers because they had not moved away to a safe distance from the bus doors after getting off from the bus.

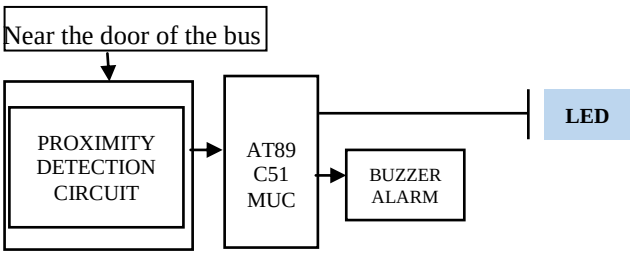

Fig 5: Block diagram of proximity detection system

To avoid such accidents this paper proposes the placement of IR proximity sensors near both doors of a school bus. Fig 6.1 shows the block diagram of the proximity detection system proposed to be included near the doors of the school bus system. An IR proximity sensor connected to a microcontroller will help detect human presence within a particular range (range of the IR rays) near the doors of the bus without actual contact [2].
The IR proximity sensor sends out IR rays, these rays will be reflected back if it encounters an object. The distance of the object from the door of the bus can be determined by the strength of the reflected rays. If the reflected rays are too strong, this indicates that the object is too close to the door. This will set off the buzzer and issues a warning to the driver. Also the LED corresponding to the proximity detection system will light up as an indication. Proximity sensors are widely used in automatic car parking systems [2].

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VII. PROPOSED TOPOLOGY

This paper is mainly designed to help reduce the increasing number of accidents involving school buses. Few of the main reasons that have to be overcome such as overloading of school buses and the sheer negligence of the bus drivers are addressed in this paper. The combination of overload detection system, pressure detection system and proximity detection system together form the backbone of this proposed bus system. All of these three systems are connected to a buzzer and a LED panel board to alert the driver about these accident or injury prone conditions. Fig 7.1 shows the block diagram of the proposed topology.

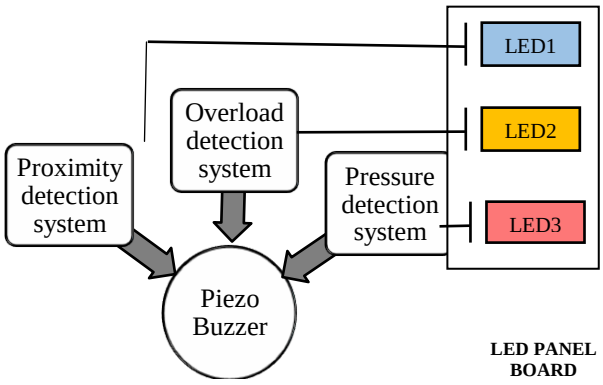

Fig 6: Block diagram of proposed topology

This proposed topology will help control the increasing number of accidents concerning school buses.

VIII. CONCLUSION

The overload control system and proximity control system adopt the infrared principle to count the number of students and also to determine the presence of students near the bus. Alerting system and indication systems are provided to give real time warning to the bus drivers and concerned care takers.

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