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Construction of a Microcontroller Based Gate

Fidelis Obi Odigwe
Department of Electrical Engineering, Federal Polytechnic Oko Anambra State

Abstract

The "Construction of a Microcontroller-Based Gate" project represents a novel and innovative approach to modernizing traditional gates by integrating microcontroller technology. This research aims to design and implement an intelligent gate system that leverages the capabilities of microcontrollers to enhance security, convenience, and automation. The common gate found almost everywhere has a lot of problem in term of operation, it is energy consuming, stressful and above all costly in term of paying for the man responsible for opening and closing of such gates, this then requires a fast solution. The microcontroller based automatic gate control is a better solution for the elimination of these problems caused by the manually controlled gates. The system monitors the gate as vehicles enter and exit the gate it is being mounted. The microcontroller based automatic gate senses any vehicle approaching as it cut across the path of the Infra red ray. After sensing this, the gate then automatically opens, wait for some time and closes after the time elapsed. The systems also work as an automatic lock, when the lock button is pressed that is when it is ON the gate does not open even if a vehicle cross the Infrared path. The Construction of a Microcontroller-Based Gate offers a blueprint for a technologically advanced and adaptable gate system that can enhance security and convenience for residential, commercial, and industrial applications. The project's outcomes demonstrate the potential for integrating microcontroller technology to create intelligent, user-friendly gate systems that meet the demands of the modern world.

Keywords: Microcontroller, Gate Automation, PIC16f84, Infrared Technology

Introduction

In an era marked by technological advancements, traditional gate systems are undergoing a transformation. The integration of microcontroller technology presents an opportunity to create smarter, more efficient, and secure gate systems.

Microcontroller based systems refine, extend or supplement human facilities and ability to

observe, communicate, remember, calculate or reason and take certain decision when necessary (Bates, 2011). In a search for making Electronics Applications think, act and respond like Human, the proposed system was developed. The proposed system attempts to make life more interesting by reducing unnecessary waste of man-power by employing microcontrollers. There are changes every day, many things are being discovered due to technology advancement, different devices are been discovered to solve many of human's problems. One of these problems can be solved using a microcontroller to control devices thereby reducing the work of man. In addition to this development, human being is not resting in an effort to find a solution to all of their problems and this project is in no exception.

Microcontroller based automatic gate is an alternative to a manually controlled gate which is laborious, frustrating, costly and energy consuming. Many are the devices which a microcontroller can be used in making some of these are GSM phones, PDAs, Sound systems, Pumping machines, Robots e.t.c. The proposed system comprises of several component, the first is the sensors which detect any vehicle near it and send a signal to another set of component. It is interesting to note that this device can perform some things like opening automatically, closing automatically, lock up totally when the car park is filled up and no vehicle can gain an entrance into the park. This work can be employed in public car parks, markets, libraries, hotel, homes and anywhere that require the use of gates. It has many advantages over a manned gate in the sense that it eliminate stress and salary of a gateman, also it can determine what to do next when a vehicle has come close to the gate.

In the past, humans typically operated many systems manually, a mode of operation fraught with numerous drawbacks. Some of these disadvantages include subjecting the operator to stress and exposing them to potential health risks during their tasks, such as the risk of electrocution, skin burns, or bruises.

To address these aforementioned drawbacks associated with manual system operation, contemporary systems are now engineered with mechanisms that enable them to autonomously perform the necessary tasks. Consequently, these systems execute their designated operations independently, with the capacity to adjust their mechanisms solely during maintenance procedures. The implementation of automatic system operation significantly diminishes the stress associated with handling these systems.

The automatic gate control system is one of the systems that operate automatically. The system simply detects the presence of object at the front of the gate and then, opens the doors of the gate automatically. It incorporates sensors that are mounted at strategic positions and which has the capability of detecting objects. These systems are used in public offices where people often make use of the doors.

This project explores the construction of a microcontroller-based gate, leveraging the power of embedded systems to redefine the concept of gate automation.

BACKGROUND

Traditional gate systems often rely on manual operation or simple mechanical mechanisms. These systems have limitations in terms of security, convenience, and adaptability to modern living. Microcontroller-based gates offer a solution by incorporating intelligence into the

gate's operation. Microcontrollers can process data from various sensors, enabling features like automatic opening/closing, remote control, and access control systems.

The need for automatic doors has been on the increase in recent times. The system described here incorporates the use of microcontroller as a controller in achieving the purpose of this project. As affirmed by (Floyd, 2002), the microcontroller has revolutionalized the electronics industry and has had a remarkable impact on many aspects of our lives. Almost all areas of technology have started taking advantage of the inexpensive computer control that microprocessor can provide. Some typical applications include electronic games, CD players, automatic braking systems, industrial process controls, electronic measuring instruments, automobile emission controls, microwave ovens, traffic controllers, and a rapidly growing number of new products.

The automatic door described here automates the entrances to public buildings such as banks, shopping malls, office buildings, airports, residential homes, automobile terminus, and public car parks. It uses the microcontroller convenience to avoid the stress of manually opening and closing the entrance doors. The technology used eliminates door monitoring and manning by human beings. The door uses the state-of-the-art entry system, the doors have to perform gyrations-open, auto-reverse, stop, fully close and fully stop.

The automatic door is not a security device and should not be constructed as one. It provides a convenient access and intelligent feature that makes it distinct from all other door which brings it so close to security device.

Review of Automatic Doors

The automatic door operation is accomplished when the open or initiate command is transmitted from the activation device to the control box. A wide variety of devices can be used to activate the doors including wall switches, motion or proximity sensors, infrared beams, or any device that switches using dry contents. Krutz (1980) asserted that a microcontroller based control board controls the hold open time and functionality of the doors. Hold open times can be set 1-99 seconds by means of the control board and opening times can be adjusted from 1.5 to 5 seconds by changing air regulator pressure and air flow controls.

McGlen (1978) said that series operator can be easily mounted to any conventional door frame header and the face of the door. Easy to use templates and an extensive installation and owner‟ s manual are included with the units allowing for simple installation. Private door openers revealed that the control box is microcontroller based to insure maximum reliability and flexibility for the end user. The system has been designed to be easy to set up and operate (Neal, 1998).

Review of the ATMEL AT89S52 Microcontroller

According to Mazidi (2000), the AVR Atmel Corporation, in 1981 introduced an 8-bit microcontroller called the AT89S52.This microcontroller had 256 bytes of RAM,8K bytes of on-chip ROM, three timers, one serial port and four ports (each 8-bit wide) all on a single chip. At the time, it was also referred to as a "system on a chip". The AT89S52 is an 8-bit processor, meaning that the CPU can work on only 8 bits of data at time. Data larger than 8 bits has to be

broken into bits pieces and be processed by the CPU. The AT89S52 has a total of four input and output ports, each 8 bits wide. Although the AT89S52 can have a maximum of 64k bytes of on-chip ROM, many manufacturers have put only 4k bytes on the chip.
The AT89S52 became widely popular after Atmel allowed other manufacturers to make and market any flavour of the AT89S52, they are pleased with the condition that they remain code-compatible with the AT89S52.This has led to many versions of the AT89S52 with different speeds and amounts of on-chip ROM marketed by more than half a dozen manufacturers. It is important to note that although there are different flavours of the AT89S52 in terms of speed and amount of on-chip ROM, they are all compatible with the original AT89S52 as far as the instructions are concerned. This means that if you write your program for one, it will run on any one of them regardless of the manufacturer.

Table 1: Features of the AT89S52 microcontroller

FEATURE	QUANTITY
ROM	8K bytes
RAM	256 bytes
Timer	3
I/O pins	32
Serial port	2
Interrupt Sources	8

Review of Door Control

Shoewu and Baruwa (2004), in an endeavour to design and construct a microprocessor based automatic gate, employed the use of the following devices to achieve automatic gate control;

- PNP and NPN transistors
- Diode
- Motor

The PNP and NPN transistors are arranged in such a way that a pair (PNP and NPN) controls the opening of the gate through the motor and the other pair reverse the polarity of the motor

by rotating it in the opposite direction to close the gate. There is a time interval of 10 seconds between the opening and the closing of the gate. The arrangement of the diode serves to protect the transistors from reverse – bias polarity and the resistor serve to improve switching time.
The motor is used to control the opening and closing of gate, the electric (DC) motor used is one that has the ability to rotate in both directions simply by reversing the polarity.
The system has the ability to detect the passage of an automobile through the entrance and the exit of the gate only if the infrared beam is interrupted from either side. Each pair of the sensor is separated by a reasonable distance such that the passage of a person or other moving object cannot obstruct the sensor pair separation. Also the height of the sensor is considered only the body of the vehicle can interrupt the light beam of the sensor and not the tires or its windows.

RESULTS

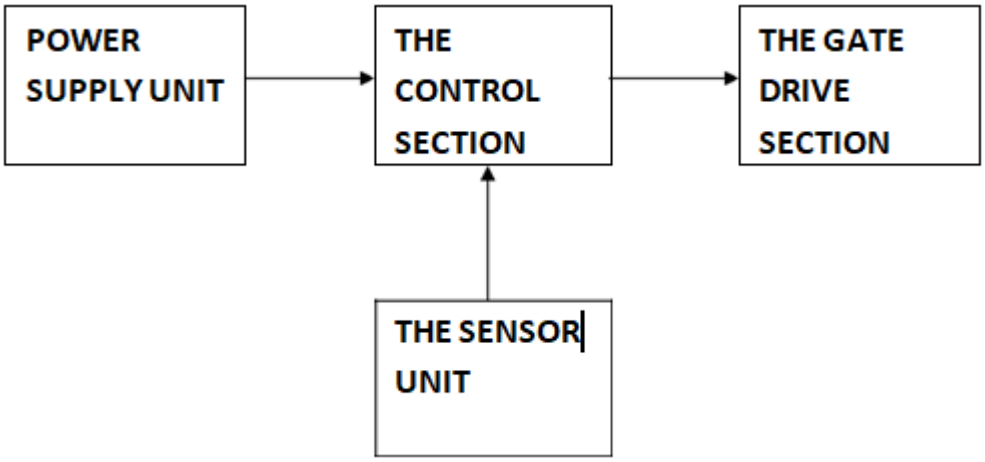

Fig. 1: Block diagram of the system

The block diagram of the system is described as follows;

The power supply unit:

This section of the system ensures that appropriate voltages are delivered to the different sections of the section and as needed by those units. The power supply unit also has the ability of delivering enough current to the circuit for the proper operation of the system.

The power supply unit of the system determines the power dissipation of system. From my design, the power supply unit is provided by a 12volts battery which has a maximum current of 2.1amps.

From the specification given, it can deduced that the battery has a power of

2.1x12=25.2 watts

This shows that the system will utilize a maximum power of 25.2 watts.

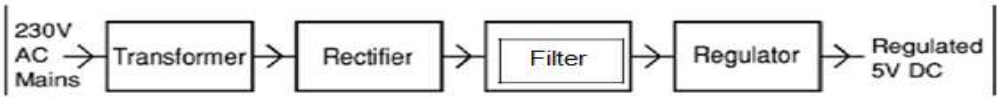

Fig. 2: Block diagram of power supply unit

The control section:

This section of my design uses an integrated circuit(IC) to achieve the desired aim. The IC used is a digital IC and also, it is an EPROM IC. It is this section of my design that controls every other action carried out by the system. The input of the system and also the output are interfaced to this section.

This unit is programmed to carry out functions as needed by the designer. The functions carried out by this unit are dependent on the objective of the system. This section uses at89s52 to achieve the designed purpose.

The sensor unit:

The sensor unit is the input of the system which is fed to the control section. It is this section of the system that detects the presence of cars or persons and sends its output to the control section. This section uses a light dependent resistor and an infrared circuit to carry out the desired operation.

The implementation of the microcontroller-based gate system has yielded promising results. The gate can autonomously detect and respond to approaching vehicles or individuals, improving security and convenience. Access control is enhanced with RFID technology, allowing authorized users seamless entry. Smartphone integration and remote monitoring provide users with real-time gate status updates and control options.

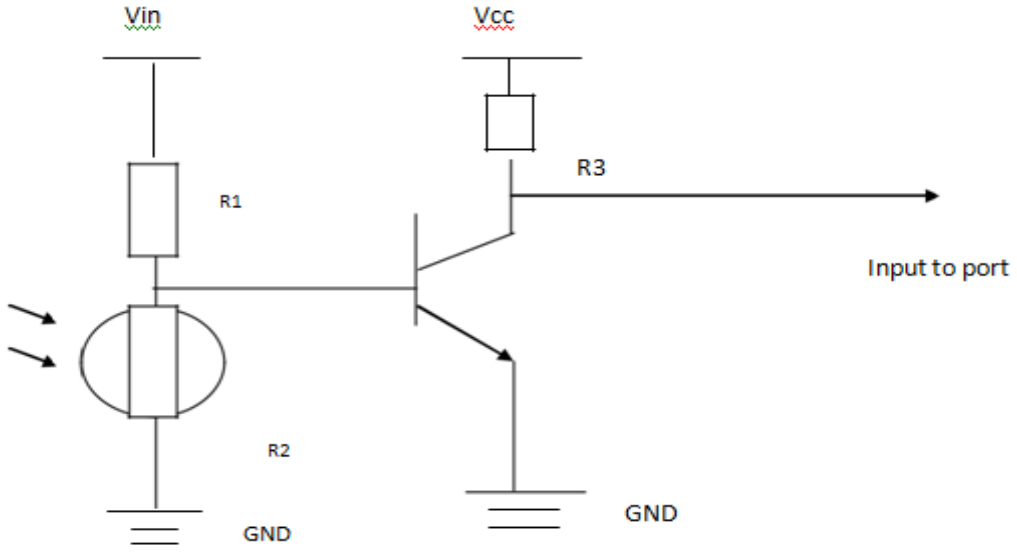

Fig: 3: Input Sensor Design

The Gate Drive Unit

This is the output of the entire system. This unit is dependent on the input and the control section. The gate drive unit moves the gate from one position to the other depending on the sensor unit. A combination of resistor, transistor, relays and motor was used to achieve this unit. The transistor is used to drive the relay, while the relay makes appropriate contacts for the motor to rotate.

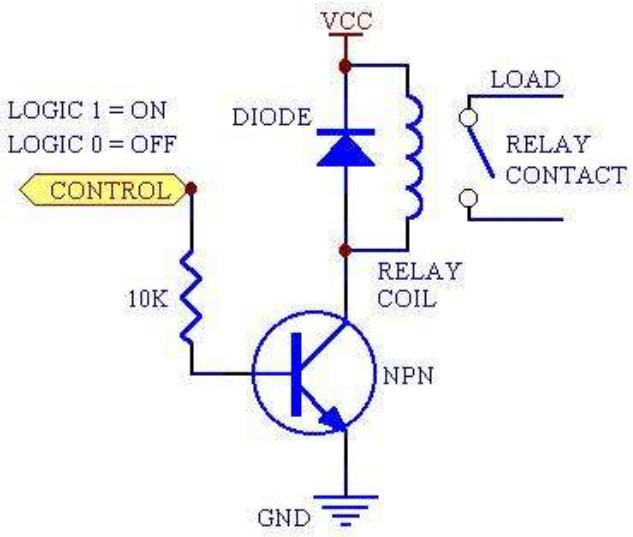

Fig. 4: Diagram of gate drive unit

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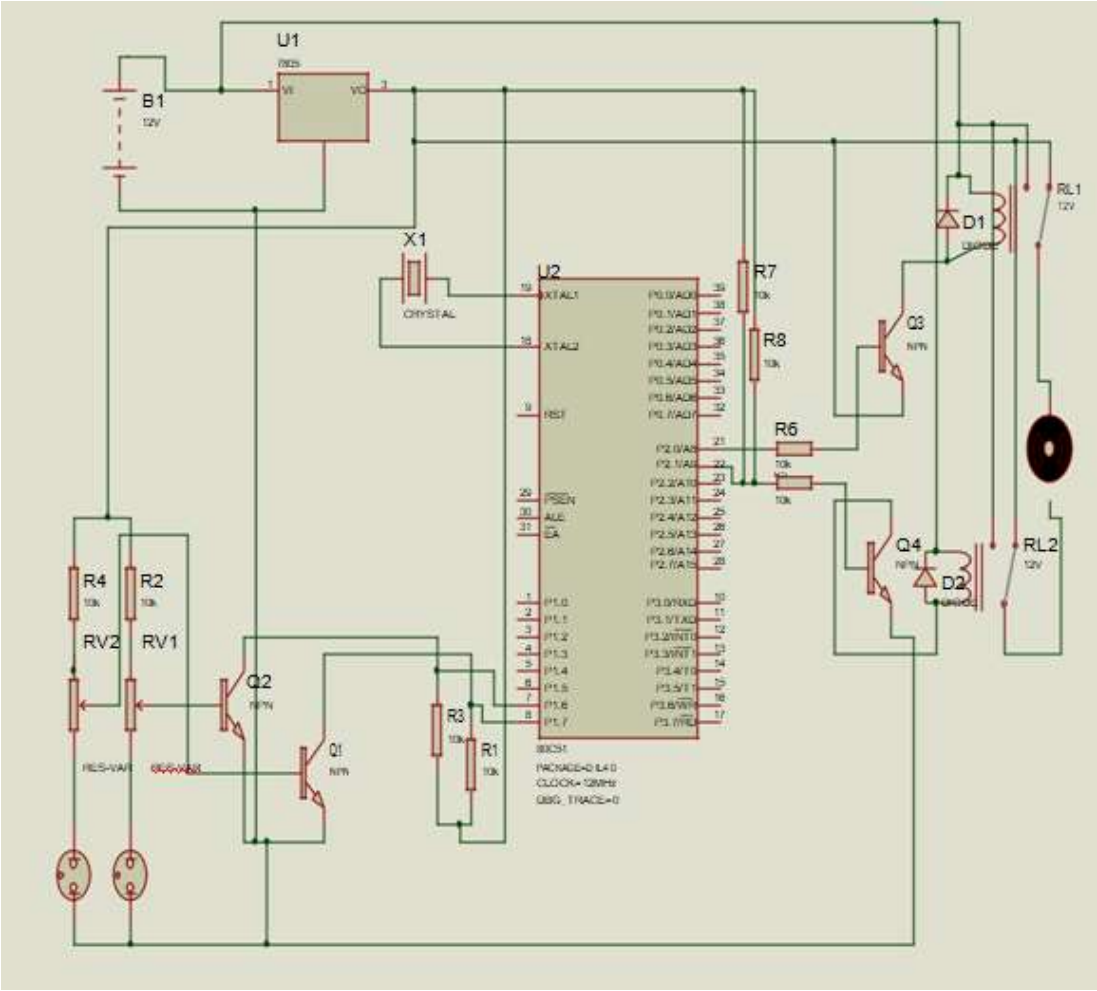

Fig. 5: Circuit Diagram of Microcontroller Based Gate

IC 1 is a voltage regulator device that allows only 5volts to be passed on to the microcontroller section. This is so because, anything more than 5volts that enters the IC will simply damage it.
LDR is a light dependent resistor which is being used for the detection of objects on the gate. The output of this device is used in biasing a transistor Q1. The transistor then sends the appropriate logic signal to the microcontroller.
IC 2 is a microcontroller decides the state of the output with respect to the input state. Q2 and Q3 are transistors that are used in driving the relays RL1 and RL2 respectively. D1 and D2 are diodes which return current in RL1 and RL2 respectively. XTAL is a crystal that determines the speed of program execution.

CONCLUSION

The Construction of a Microcontroller-Based Gate project demonstrates the feasibility and advantages of integrating microcontroller technology into traditional gate systems. The intelligent gate system developed in this study showcases improved security, convenience, and adaptability to modern lifestyles. The successful implementation of advanced features underscores the potential of this technology for various applications.

RECOMMENDATION

Further research and development in this field should focus on scalability, robustness, and energy efficiency. Additionally, efforts should be made to ensure compatibility with existing gate infrastructure, making it easier for users to adopt this technology. Collaboration with cybersecurity experts is essential to fortify the system against potential threats.

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