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Automated Toll Plaza using Solar Energy and Fingerprint Sensor

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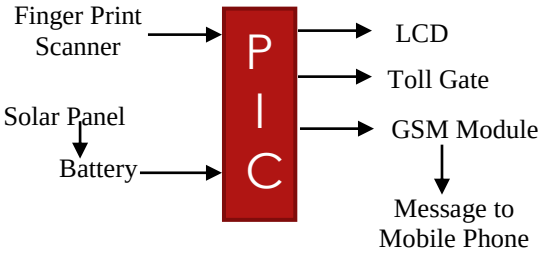
***Abstract*- This research paper describes the automated toll collection system for toll gate with the help of fingerprint sensor and solar panel. As traffic has increased drastically over the years the roads are getting congested and a huge amount of traffic is formed at toll plaza. Most of the toll collection systems commonly used in India are manual transactions. This causes traffic jam and a lot of time is wasted. Sometimes the toll workers do not have change available or are not working properly which delays the process even more. The objective of this paper is to transform manual transactions into digital transactions. It will allow users to make payment using their fingerprint as authentication. The proposed method of digital transactions will make flow of traffic from toll plaza much easier. Also in this project we are using solar panels which will be laid parallel to the road and will be used to charge the battery. And the same battery will be use for the power supply for the equipment's of the toll plaza.**

I. INTRODUCTION

Nowadays, we can often see a huge amount of traffic present on the toll plaza. As a number of people driving vehicles has increased over the years. This causes congestion on the toll plaza which make several people lose valuable time. In order to overcome this problem we have used fingerprint sensor to make transactions faster.

The fingerprint sensor matches the user information in the database and deducts amount from the users account. The stepper motor connected to the PIC microcontroller then opens the gate. The above model helps to reduce time taken in transactions and moves more vehicles through the plaza in less time. The toll plaza is operated by renewable energy collected by the solar panels and the speed breaker. The energy produced is stored in a battery which is then connected to the PIC microcontroller. An array of solar panels are placed along the toll plaza to produce the required amount of energy. Renewable sources are green sources of energy which also help us to minimize pollution caused by burning fuel.

II. BLOCK DIAGRAM



III. RELATED WORK

In the above mentioned project we have used a GSM module to provide SMS alert. So, whenever a transaction occurs the user gets a notification. MAX232 IC is used to interface fingerprint sensor (R303) and GSM module. DC motor is connected to the relay which is connected with ULN2003 which is then connected to the PIC microcontroller.

The programming of the microcontroller is done using embedded C language. MPLAB IDE was used to write and test run the code for microcontroller.

IV. MAJOR COMPONENTS OF THE HARDWARE

The major components of the hardware design are:-

- PIC Microcontroller
- MAX232
- ULN2003
- Fingerprint sensor
- LCD
- GSM module

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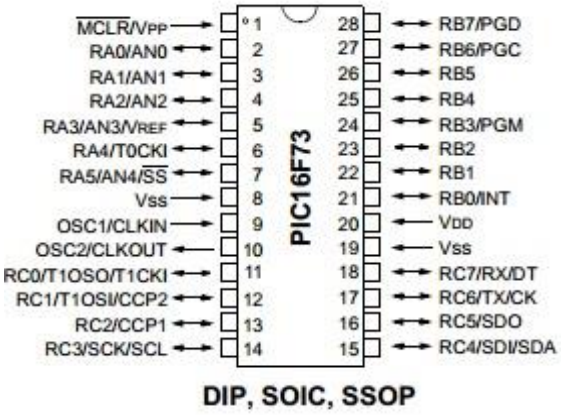
- Solar Panel
- Relay Circuit

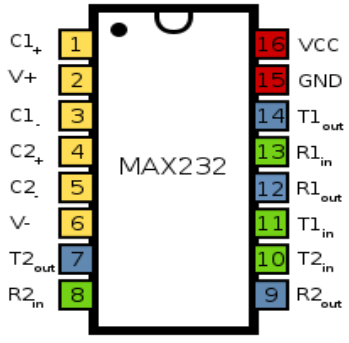
1. PIC16F73 Microcomtroller

The project consist of PIC16F73 microcontroller. This microcontroller features 5 channels of 8-bit Analog-to-Digital (A/D) converter with 2 additional timers, 2 capture/PWM/compare functions and the synchronous serial port can be configured as either 3-wire Serial Peripheral Interface or the 2-wire Inter-Integrated Circuit bus and a Universal Asynchronous Receiver Transmitter (USART). All of these features make it ideal for more advanced level A/D applications in automotive, industrial, appliances and consumer applications.



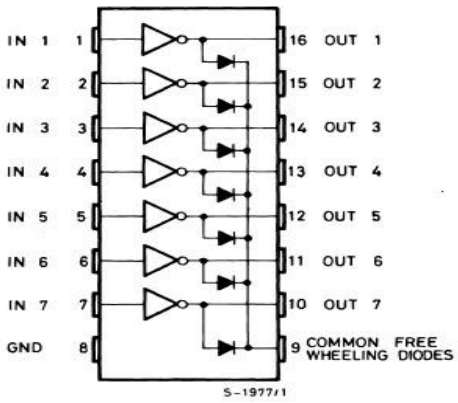
2. MAX232

This IC is widely used in RS232 Communication systems in which the voltage level is required to make TTL devices to be compatible with PC serial port and vice versa. It is a dual driver/receiver that includes a capacitive voltage generator to supply RS232 voltage levels from a single 5V supply. Each receiver converts RS232 inputs to 5V TTL/CMOS levels. In this project we interfaced GSM-800 module and R303 fingerprint sensor.



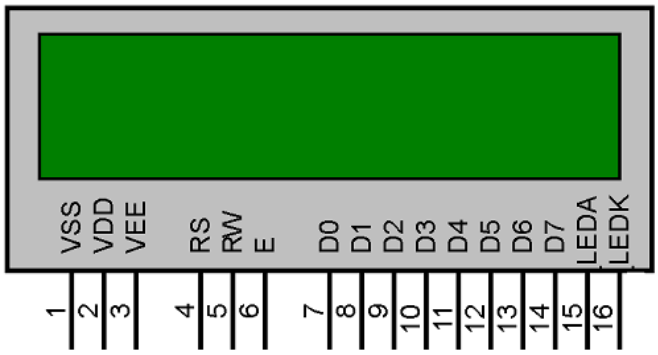
3. ULN2003

It is a relay driver IC and it is a darlington array having high voltage and high current levels as well. It is made up of seven open collector darlington pairs having common emitter which shows ULN2003 has a capability of handling different relays at a time. IC has 16 pins in total out of which there are 7 input pins, 7 output pins, 1 ground and 1 common free wheeling diode pin. In this project this IC is used to interface DC motor to the microcontroller with the help of relay.



4. LCD

The 16x2 LCD is a very basic module used in circuits. The 16x2 translates on a display 16 characters per line in 2 such lines. In this LCD each character is displayed in a 5x7 pixel matrix. LCD has two registers namely command and data. Command register stores namely the command for the LCD. Data register stores the data to be displayed on the LCD. In this project the LCD will display the information about amount deduction of the user at toll plaza.



5. Fingerprint Sensor

Fingerprint sensor are of two types which are optical and capacitive. In this project we have used an optical sensor R305. In this print sensor module with TTL UART interface for direct connections to microcontroller UART or to PC through MAX232 / USB-Serial adapter. The user can store the finger print data in the module and can configure it in 1:1 or 1: N mode for identifying the person. The FP module can directly interface with 3v3 or 5v Microcontroller. A level converter (like MAX232) is required for interfacing with PC serial port.

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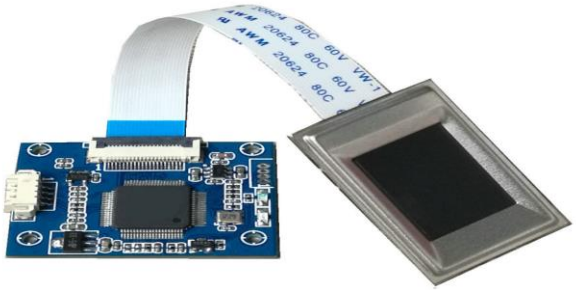


6. GSM Module

SIM900 is an ultra and reliable wireless module-S. This is a complete Quad-band GSM/GPRS module in a SMT type and designed with a very powerful single-chip processor integrating AMR926EJ-S core, allowing us to benefit from small dimensions and cost-effective solutions.

In this project a message will be sent to the user's mobile about the deduction of amount at the toll plaza.

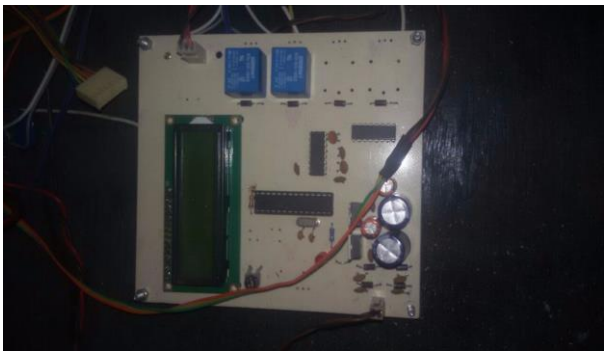
7. Solar Panel

It is a device which converts the light energy into electricity by photovoltaic effect. In this project we have placed an array of solar panels along the road side of toll plaza. The energy is then stored in a battery which is then used for the various operations of toll plaza.

8. Relay Circuit

The type of relay used in this project is Solid-State relay (SSR). An SSR is an electronic switching device. Whenever an external voltage, over a threshold is applied across its control terminals, a magnetic field is generated which attracts a movable lever, thus establishing a flow of current and switching power to a load circuitry.

In this project two relays are used which are connected to the ULN2003 and with DC motor. The DC motor is used to open the gate of the Toll Plaza. The two relays are used to rotate the motor in clockwise and anti-clockwise direction.



V. PROBLEMS FORMULATION

During the course of the project, we came across several problems that were a hurdle to the proper functioning of the project. There were hardware as well as software issues. Out of many problems occurred, some of them are:-

1. Complication with the Fingerprint sensor:

Initially while interfacing Fingerprint sensor with MAX232 and connected it to the PC through RS232 serial communication an error occurred.

2. Problem with the DC motor:

The DC motor is connected to the relay. When we started the system the DC motor starts rotating continuously. It was stopped by removing the supply from battery.

VI. PROPOSED PROBLEM SOLUTION

For the proper functioning of the project, outcomes of the problems mentioned above are as follows:

1. Solution for the fingerprint sensor: The error was shown due to the defective module. We checked it by serial communication as well as by connecting fingerprint module with USB cable. The power was shown by the module but the data can't be stored. After changing to the new fingerprint module, the new fingerprint works properly.

2. Solution for the DC motor:

While testing with the code we observed that we did not provide delay to the motor. By applying proper delay to the code we overcome with this problem for the perfect functioning of the motor.

CONCLUSION

The In this project a low cost , efficient and user friendly solution to the long lines at the toll plaza. Using a finger print sensor allows us to eliminate those long lines to make rush hour traffic less hectic. Further using renewable energy harvested from the sun using a solar power helps us to make our project environment friendly. The system is extendible and further adjustments can be made according to

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requirement. The project meets the required goals and objectives have been met.

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