WWW.IJRPR.COM

International Journal of Research Publication and Reviews

Journal homepage: www.ijrpr.com ISSN 2582-7421

Automatic Toll Collection System Using MSP430 Launchpad

D.Swathi

Assistant Professor P.V.P Siddhartha Institute of Technology, Kanuru, Vijayawada, Andhra Pradesh, India

ABSTRACT:

The purpose of an automatic toll collection system is to collect tolls in a more efficient and timely manner. It's a fantastic alternative to standing in line for hours at a manual toll booth, allowing you to save both time and money. As a microcontroller, we're using RFID (Radio Frequency Identification) technology with an MSP430 launchpad. RFID cards are one-of-a-kind identifiers given to each vehicle. The RFID card reader reads the card information and passes the ID to the microcontroller whenever a vehicle with such a unique ID arrives at the toll plaza. As a result, the microcontroller operates and deducts a certain amount from the prepaid card. The microprocessor will order the DC motor to start and open the gate, allowing the vehicle to pass if the card's ID is legitimate and there is adequate balance on the card. The deduction and current amount of the card will be displayed on the screen as you exit the gate.

Keywords: Radio Frequency Identification (RFID), RFID reader, Toll plaza, MSP430 launchpad.

1. Introduction

To go on a toll road, you must pay a toll, which is a cost or penalty. The majority of highways are funded by taxes produced by the municipal, state, or federal governments. Tolls are a type of tax that only applies to toll road users. Toll roads allow for the construction and maintenance of new roadways without raising taxes for the general population. However, a toll road does not always remain a toll road indefinitely. When the cost of construction has been repaid from tolls collected, tolls are sometimes removed from roadways.

A toll plaza is a gated area where you must slow down or stop in order to pay a toll in order to continue driving. To keep traffic moving as rapidly as possible, there are frequently multiple open lanes with toll booths. Toll booths may be present in some lanes, allowing you to pay with change or cash. Because the number of vehicles on the road is continually increasing, these lanes are becoming increasingly congested.

The goal of this method is to reduce the length of time spent in a long line, improve cashless payments, reduce fuel consumption, reduce fuel waste, and ease the stress on toll plaza management employees. We're employing RFID technology, which gives each car a unique ID when they register their information.

2. Literature Survey

2.1 MSP430 LaunchPad

Integrated full-speed USB 2.0 (HID/MSC/CDC) allows you to create low-power, PC-connected apps. The MSP-EXP430F5529LP LaunchPad (Fig.1) is a low-cost, easy-to-use development kit for the MSP430F5529 USB microcontroller. With an onboard emulator for programming and debugging, as well as buttons and LEDs for a simpler user interface, it's a simple way to get started creating on the MSP430 MCU.

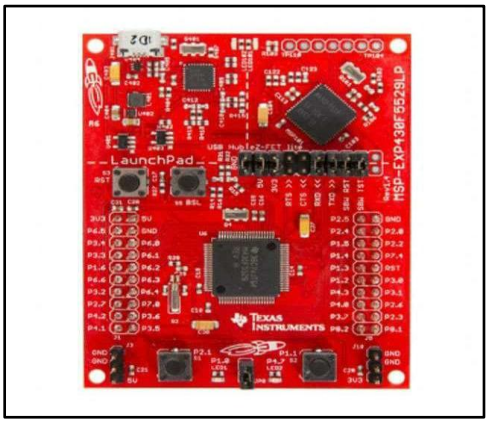

Figure 1: MSP-EXP430F5529LP LaunchPad

With 40-pin Booster Pack extension headers and a large choice of Booster Pack plug-in development board modules, rapid prototyping is a breeze. Wireless, displays, sensors, and other functionalities can be added fast. The MSP430F5529LP LaunchPad features a 16-bit MCU with 128Flash, 8 KB RAM, up to 25MHz CPU speed, inbuilt USB2.0 PHY, 12-bit analog to digital converter (ADC), timers, serial communication (UART, I2C, SPI), and more.

2.2 Energia

Energia is an open source electronics prototyping platform founded in January 2012 by Robert Wessesls with the objective of bringing the Wiring and Arduino framework to the Texas Instruments MSP430-based LaunchPad. The Energia IDE runs on Mac OS, Windows, and Linux and is cross-platform.LaunchPad can be used in conjunction with Energia to create interactive devices that take input from a range of sensors and control a variety of lights, motors, and other physical outputs.

2.3 RFID (Radio Frequency Identification)

A transponder/tag connected to a vehicle and a transceiver, also known as an interrogator/reader, are the two major components of an RFID (Radio Frequency Identification) system. A reader is made up of a Radio Frequency module and an antenna that produce high-frequency electromagnetic fields.The tag, on the other hand, is usually a passive device, which means it doesn't have a battery. Instead, it has a microchip that stores and processes data, as well as an antenna for receiving and transmitting signals.

A tag must be put close to the Reader in order for the information encoded on it to be read (does not need to be within direct line-of-sight of the reader). A reader creates an electromagnetic field that causes electrons to flow via the tag's antenna, powering the chip.

The powered chip inside the tag then replies by sending another radio signal to the reader with the information it has saved. Backscatter is the term for this phenomenon. The reader detects and interprets the backscatter, or change in the electromagnetic/RF wave, and then delivers the data to a computer or microcontroller.

.

Figure 2:RFID tag and reader

3. Methodology

Automatic toll collection systems rely on four major steps: automatic vehicle identification, automated vehicle classification, transaction process and violation enforcement.

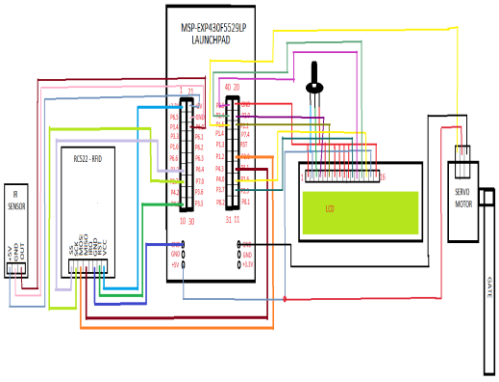

Figure3:Circuitdiagram of Automatic toll collection system

3.1 Automated vehicle identification

The method of establishing the identity of a vehicle subject to tolls is known as automated vehicle identification. We're employing an infrared obstacle sensor for this. An infrared sensor is a light-emitting electrical gadget that detects automobiles on the road.
An infrared sensor can detect motion as well as measure the heat of an object. Almost all items emit some type of thermal radiation in the infrared range. These sorts of radiations are undetectable to the naked eye, but they can be detected by infrared sensors.

3.2 Automated vehicle classification

Automated vehicle classification and automated vehicle identification are closely connected. Most toll facilities charge different fees for different types of vehicles, necessitating the identification of the vehicle passing through.
Every car has an RFID tag with a unique ID that communicates vehicle information to the RFID reader, such as vehicle type, registration number, and so on. Providing distinct lanes and RFID tag colors for different sorts of cars is a simple and effective technique to classify them.

3.3 Transaction processing

Client accounts are maintained, toll transactions and customer payments are sent to the accounts, and customer enquiries are handled through transaction processing. Prepaid accounts allow customers to fund a balance in their account, which is then decreased as toll transactions are processed.
The RFID reader examines the tag's unique ID and then double-checks the data. If the customer's prepaid account is depleted, the LCD (liquid crystal display) will display a message such as "Your card is depleted," and the vehicle will be directed to the manual lane. Otherwise, deducts the amount of money from his/her prepaid card and displays a message indicating the amount deducted as well as the card's current balance on the LCD display.

3.4 Violation enforcement

A physical barrier, such as a gate arm, assures that every vehicle passing through the toll booth has paid their toll. The microcontroller sends instructions to the servo motor to open the gate after each transaction. After the vehicle has passed, the motor closes the gate again because it receives feedback on the present location of the motor shaft.

4. Implementation:

Taking an Arduino-based project and adapting it to the MSP430F5529 microcontroller presents some hurdles at first. Some connection issues and programming glitches were among the hurdles. Using the Energia software to convert Arduino code to MSP430 code resulted in a lot of problems at first. We finally completed the job by overcoming hurdles with the help of various references and suggestions. Giving instructions to each module at a specific moment is the most difficult fault in the code. Learning about the MSP430F5529 microcontroller and using it with energia took some time.

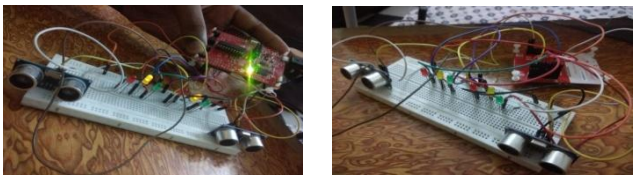

Figure 5:Complete Setup

5. Conclusion

The authors of this paper explore the use of RFID technology to construct an automatic toll collection system on the MSP430F5529 LaunchPad. All of the components' hardware interfaces are also shown in the circuit diagram. For this project, the Energia platform is utilized to dump software code into microcontrollers. Maintaining a toll plaza in a simple manner is really beneficial.

6. Future Prospects

This autonomous toll collection system can be modified in the future by adding GPS tag monitoring. If any prepaid card holder has an insufficient balance while traveling through this toll gate, the card will be disabled. To avoid this, a GPS tracking system follows the card on the vehicle, and if the vehicle gets within 100 meters of any toll gate, an SMS will be sent to the registered cell phone indicating whether the card has adequate balance. This is something that can be done in real time.

.References

[1] *MSP430F522x, MSP430F551x Mixed-Signal Microcontrollers data sheet* [Online]. Available from: https://www.ti.com/lit/ds/symlink/msp430f5528.pdf?ts=1613492226530&ref_url=https%253A%252F%252Fwww.google.com%252F.

[2] Adrain Fernandez, Dung Dang. *Getting started with MSP430 Launchpad*. [Online]. Available from:https://www.google.co.in/books/edition/Getting_Started_with_the_MSP430_Launchpa/kf5MKK9wP-4C?hl=en&gbpv=0.

[3] Klaus Finkenzeller, "*RFID Handbook: Radio-Frequency Identification Fundamentals and Applications*". John Wiley & Sons, 2000.

[4] RFID based toll collection system 2011 IEEE third international Conference.

[5] Rishab Jain, 2018. "*RFID interfacing with MSP430 Launchpad"*. [Online]. Available from: https://circuitdigest.com/microcontroller-projects/rfid-interfacing-with-msp430-launchpad.

[6] Pantech, 2020. How to interface LCD with MSP430F5529 MSP430 Development Board. [Online]. Available from:https://www.pantechsolutions.net/blog/how-to-interface-lcd-with-msp430f5529-msp430-development-board/#:~:text=Interfacing%20LCD%20with%20MSP430F5529&text=In%204%2Dbit%20interface%207,and%20control%20signal%20(E).