Report on

Automatic Toll Collection System Using RFID

BACHELOR OF TECHNOLOGY

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SYMBIOSIS

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Abstract

The automated toll collection system using passive Radio Frequency Identification (RFID) tag emerges as a convincing solution to the manual toll collection method employed at tollgates. Time and efficiency are a matter of priority of present day. In order to overcome the major issues of vehicle congestion and time consumption RFID technology is used. RFID reader fixed at tollgate frame (or even a hand held reader at manual lane, in case RFID tagged vehicle enters manual toll paying lane) reads the tag attached to windshield of vehicle. The object detection sensor in the reader detects the approach of the incoming vehicle's tag and toll deduction takes place through a prepaid card assigned to the concerned RFID tag that belongs to the owners' account. This makes toll gate transaction more convenient for the public use.

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1. Introduction

As we all know that transportation is the backbone of any country's economy. Improvement in transportation systems result into the good lifestyle in which we achieve extraordinary freedom for movement, immense trade in manufactured goods and services, as well as higher rate of employment levels and social mobility. In fact, the economic condition of a nation has been closely related to efficient ways of transportation. Increasing number of vehicles on the road, result into number of problems such as congestion, accident rate, air pollution and many others. All economic activities for different tasks use different methods of transportation. For this reason, increasing transportation is an immediate impact on productivity of nation and the economy. Reducing the cost of transporting resource at production sites and transport completed goods to markets is one of the important key factors in economic competition. Automatic toll collection is a technology allows the automated electronic collection of toll costs. As it is studied by researchers and also applied in various expressways, bridges, and tunnels require such a process of Automatic Toll Plaza. ATP is capable of determining if the vehicle is registered or not, and then informing the management center about to process violations, debits, and participating accounts. ATP system is that it is capable of eliminate congestion in toll plaza, especially during those seasons when traffic seems to be higher than normal. The Benefits of this System are:

- Shorter queues at toll plazas by increasing toll booth service rates.
- Faster and more efficient service
- The ability to make payments by keeping a balance on the card itself and •
- The use of postpaid toll statements
- Other general advantages include minimization of fuel wastage and reduced emissions by reducing deceleration rate, waiting time of vehicles in queue, and acceleration.

For Toll Operators, the benefits include:

- Lowered toll collection costs
- Better audit control by centralized user account
- Expanded capacity without building more infrastructures.

Thus, the ATP system is useful for both the motorists and toll operators; this is the reason of extended use of ATP system throughout the world.

2. Proposed System

This project deals with the simplification of procedure followed by passengers to pay toll at toll collection booths, like making it automated, vehicle theft detection, rule breaking etc. All these activities are carried out using single smart card (RFID tag), thus saving the efforts of carrying money and records manually.

Automatic Toll Collection: The RFID Readers mounted at toll booth will read the prepaid RFID tags fixed on vehicles' windshield and automatically respective amount will be deducted.

3. Methodology

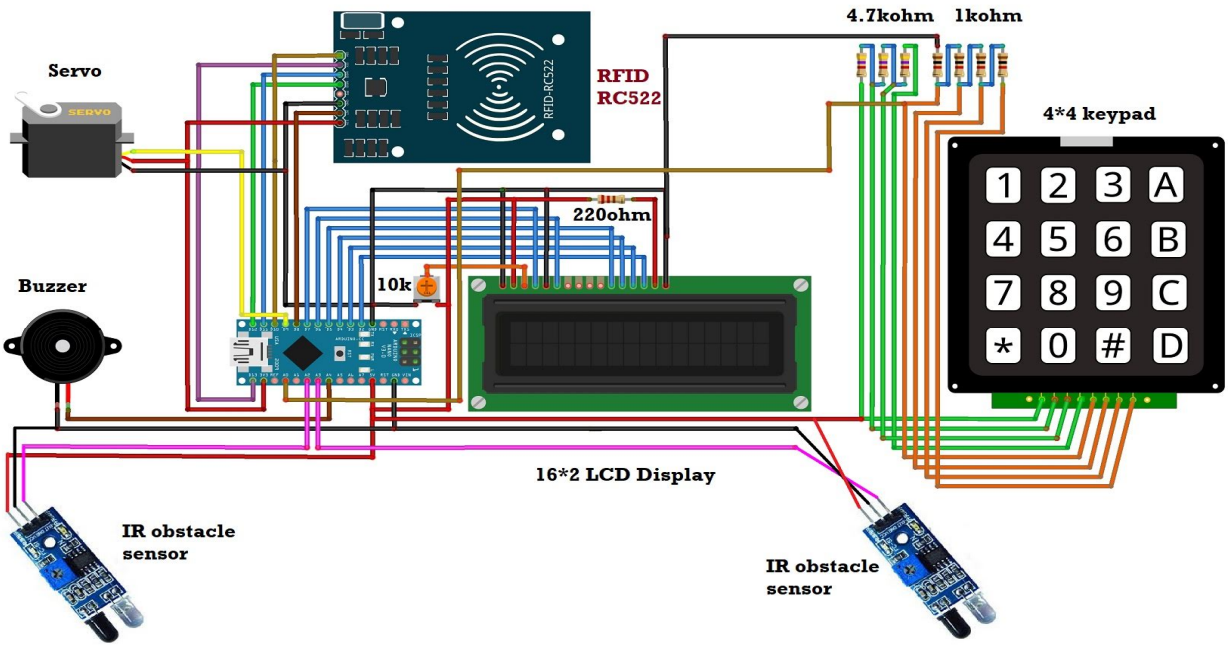
Flow chart of RFID based toll tax is:

- Detection of vehicle
- Display of toll
- Payment through RFID card

Whenever any person buys a vehicle, first he/she need to do her vehicle registered at the RTO office. RTO people will assign a number plate to it along with it they will give a RFID enabled tag. This card will have a unique ID feasible to use with that vehicle only. They will also create an account for that particular smart card and maintain transaction

history in database. Owner of the vehicle needs to deposit some minimum amount to this account. Every time a registered vehicle approaches the toll booth, first the infrared sensors will detect the presence of the vehicle which in turn activate the RFID circuit to read the RFID enable smart card fixed on the windscreen of the vehicle. Transaction will begin, depending upon the balance available toll will be deducted.

4. Circuit Diagram

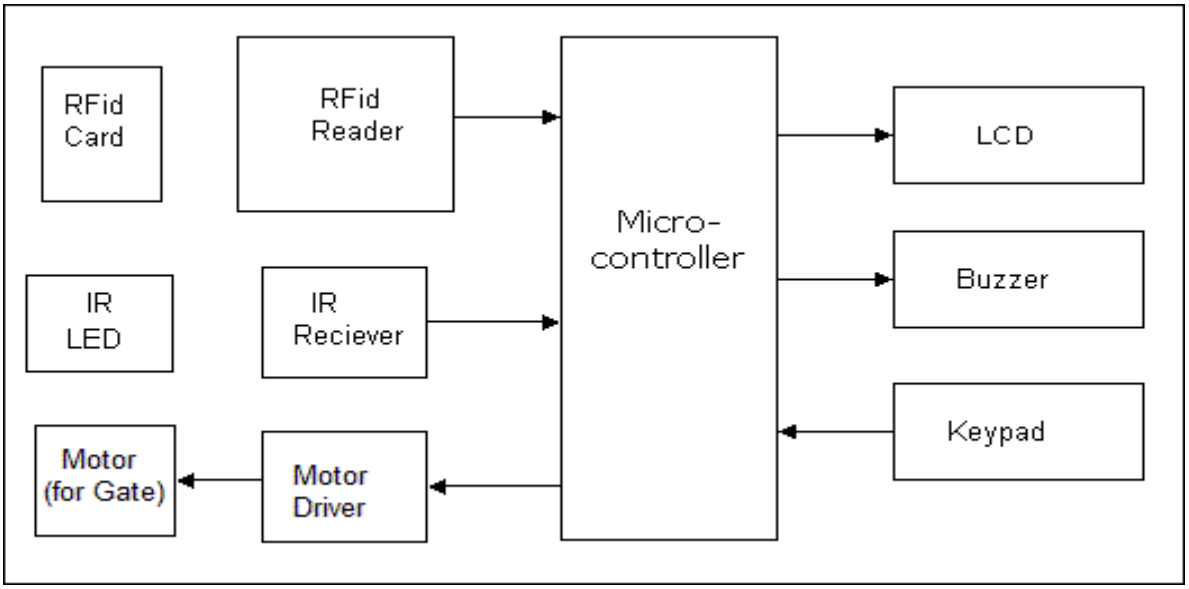


5. Working Principle

In my project, I have a vehicle equipped with RFID tag .Whenever the vehicle enters the infrared sensor detects the presence of vehicle, it rfid reader decodes the code assigned to that particular tag. After receiving the code, it is forwarded to the computer situated at the Toll station. The computer then recognizes the code and automatically access the database and if the vehicle has its valid prepaid account at the toll station, the appropriate toll is deducted from that account and the gate is opened to allow the vehicle to pass. And if the vehicle doesn't have a valid prepaid account. By using the database we can avoid necessity to transmit entire data from tag thus enabling us to use tag with very less memory requirement, that we store only 4 or 6 digit code number in the Tag. And this 4 or 6 digit code is related to the database which is related to the database which is present

on the computer. Each Tag has different code number. It also reduces error probability and saves processing time.

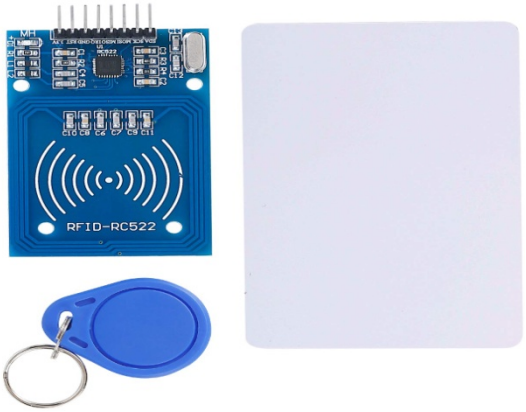
6. Block Diagram



7.1. Radio-frequency identification (RFID)

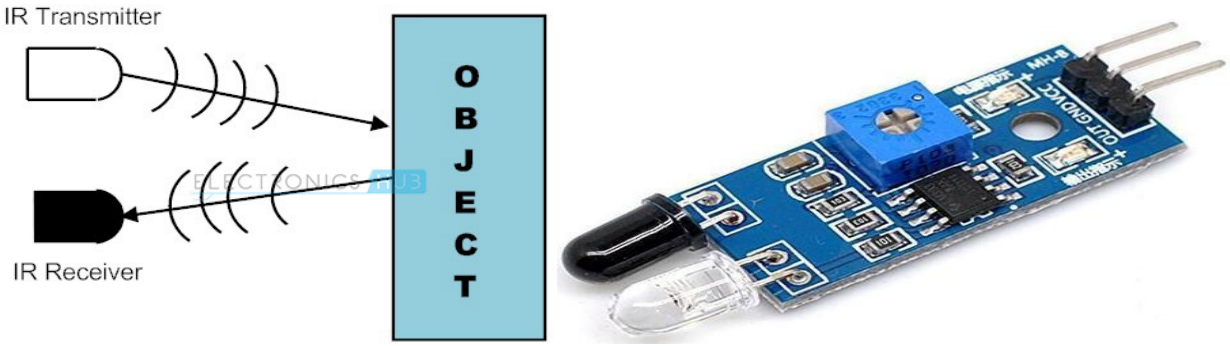
RFID is an acronym for “radio-frequency identification” and refers to a technology whereby digital data encoded in RFID tags or smart labels (defined below) are captured by a reader via radio waves. RFID is similar to barcoding in that data from a tag or label are captured by a device that stores the data in a database. RFID, however, has several advantages over systems that use barcode asset tracking software. The most notable is that RFID tag data can be read outside the line-of-sight, whereas barcodes must be aligned with an optical scanner. RFID belongs to a group of technologies referred to as Automatic Identification and Data Capture (AIDC). AIDC methods automatically identify objects, collect data about them, and enter those data directly into computer systems with little or no human intervention. RFID methods utilize radio waves to accomplish this. RFID tags contain an integrated circuit and an antenna, which are used to transmit data to the RFID reader (also called an interrogator). The reader then converts the radio waves to a more usable form of data. Information collected from the tags is then

transferred through a communications interface to a host computer system, where the data can be stored in a database and analyzed at a later time.



7.2. Infrared Sensors (IR Sensors)

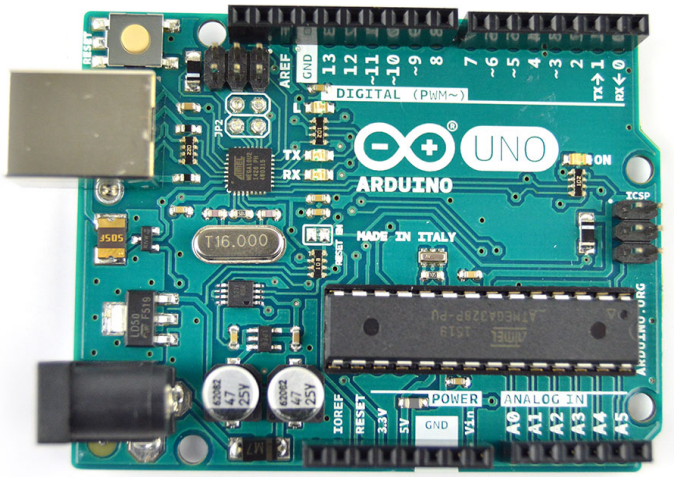
IR Sensors work by using a specific light sensor to detect a select light wavelength in the Infra-Red (IR) spectrum. Active infrared sensors consist of two elements: infrared source and infrared detector. Infrared sources include an LED or infrared laser diode. Infrared detectors include photodiodes or phototransistors. The energy emitted by the infrared source is reflected by an object and falls on the infrared detector.



7.3. Micro- Controller

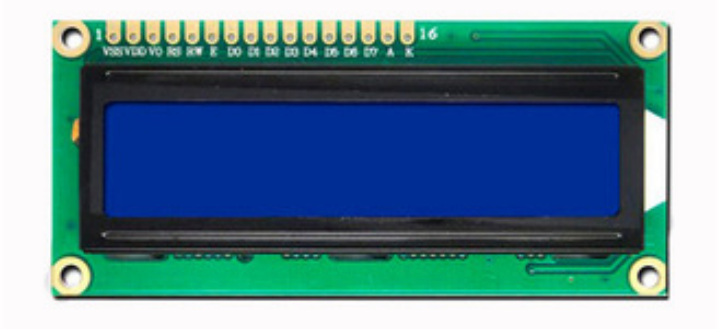
A microcontroller is a compact integrated circuit designed to govern a specific operation in an embedded system. A typical microcontroller includes a processor, memory and input/output (I/O) peripherals on a single chip. Arduino is an open-source platform used for building electronics projects. Arduino consists of both a physical programmable circuit board (often referred to as a microcontroller) and a piece of software, or IDE (Integrated Development Environment) that runs on your computer, used to write and upload computer code to the physical board. The board is equipped with sets of digital and analog input/output (I/O) pins that may be interfaced to various expansion

boards (shields) and other circuits.The board has 14 digital I/O pins (six capable of PWM output), 6 analog I/O pins, and is programmable with the Arduino IDE (Integrated Development Environment), via a type B USB cable.It can be powered by the USB cable or by an external 9-volt battery, though it accepts voltages between 7 and 20 volts. It is similar to the Arduino Nano and Leonardo.



7.4. Liquid Crystal Display

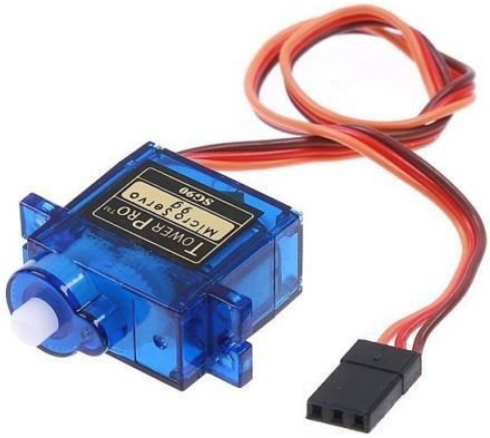
An LCD (Liquid Crystal Display) screen is an electronic display module and has a wide range of applications. A 16x2 LCD display is very basic module and is very commonly used in various devices and circuits. A 16x2 LCD means it can display 16 characters per line and there are 2 such lines.



7.5. Servo Motor

A servo motor is an electrical device which can push or rotate an object with great precision. If you want to rotate and object at some specific angles or distance, then you use servo motor. It is just made up of simple motor which run through servo mechanism. If motor is used is DC powered then it is called DC servo motor, and if it is AC powered

motor then it is called AC servo motor. We can get a very high torque servo motor in a small and light weight packages.



8. Result

RFID based toll collection system is used as a technology for fast and efficient collection of toll at the toll booths. This is possible for the vehicles passing through the toll plaza need not stop to pay toll and the payment automatically is deducted from the account of the driver. These rfid (tags) are fitted on the windshield of the vehicle . The tags have all the information regarding the users account. The rfid reader continuously send radio frequency pulses which returns only when hits a rfid tag. These pulses are returned back from the tag and are received by the rfid reader. These reflected pulses from the tags contain information about the driver number, drivers account, balance etcThe main system components are as follows:

1) RFID tagged vehicle
2) Toll booth equipped with RFID scanners
3) Sensors

9. Conclusion

The electronic toll collection system in expressway based on RFID, a design scheme was put forward. It has characteristics of low cost, high security, far communication distance and high efficiency, etc. It not only can improve technology level of charge, but also improve passage ability of expressway. Automatic toll plaza system is an effective

measure to reduce management costs and fees, at the same time, greatly reduce noise and pollutant emission of toll station. In the design of the proposed automatic toll collection system, real time toll collection and anti-theft solution system can be designed. This reduces the manual labour and delays that occur on roads. This system of collecting tolls is eco-friendly and also results in increased toll lane capacity. Also an anti-theft solution system module which prevents passing of any defaulter vehicle can be implemented, thus assuring security on the roadways.

10. Appendix

Table 1: features of RFID chip EM-18

RF transmit frequency	125KHz
Supported standards	EM4001 64-bit RFID tag compatible
Communications Interface	TTL Serial Interface,Weigand output
Communications Protocol	Specific ASCII
Communications Parameter	9600 bps,8,N,1
Power Supply	4.6V-5.5V DC +/- 10% regulated
Current Consumption	50mA<10mA at power down mode
Reading Distance	Up to 100mm,depending on tag
Antenna	Integrated
Size(L*W*H)	32*32*8mm

Following are the features and advancement of RFID Toll Booth System over presently existing system:

1) RFID tag cannot be cloned, so cannot be cheated.
2) Very efficient saving of time.
3) Wastage of money reduced.
4) Consumption of oil is reduced.
5) Pollution is reduced to a large extent.
6) Speedy transport.
7) Less congestion on the roadways.
8) Comparatively less maintenance cost .

11. Work Cited

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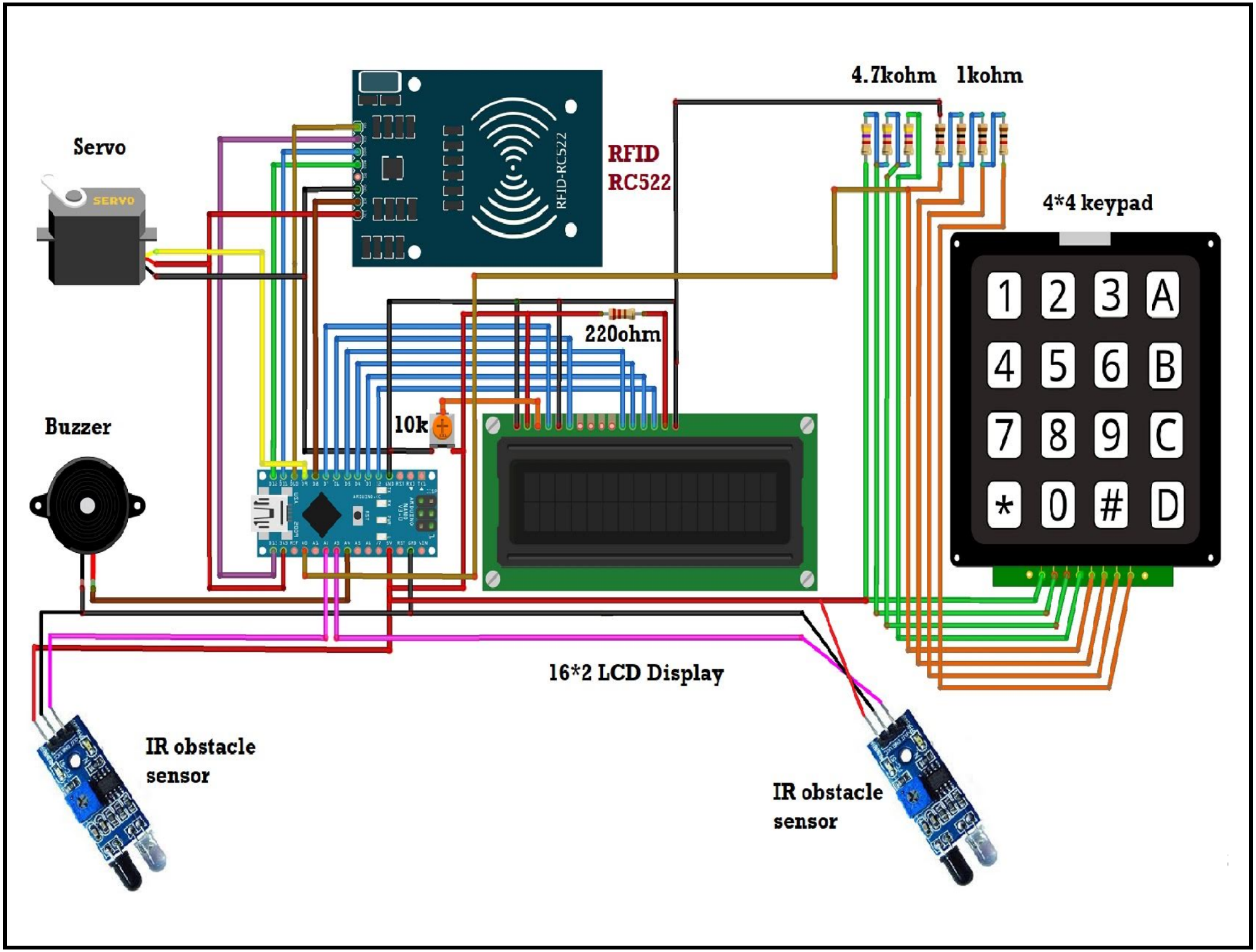
Servo
SERVO
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RC522
RFID-RC522
4.7kohm
1kohm
4*4 keypad
1 2 3 A
4 5 6 B
7 8 9 C
* 0 # D
220ohm
10k
Buzzer
16*2 LCD Display
IR obstacle
sensor
IR obstacle
sensor