SECURITY ENABLED CAPACITIVE DISCHARGE IGNITION USING AVR MICROCONTROLLER

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Abstract

Capacitive Discharge Ignition (CDI) or thyristor ignition is widely used automotive electronic ignition system. A general Capacitive Discharge Ignition module is composed of a small transformer, circuits for the purpose of charging capacitor, and generating triggering pulses and a voltage capacitor. An ignition key is being used to turn on and turn off ignition in motor vehicles and automobiles. Embedded system provide the opportunity to replace the need of ignition key in a better and secure manner with password based login interface to allow user to turn on and subsequently turn off ignition at the desired time.

Keywords: *Electronic Ignition System, CDI and Embedded System etc…*

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1. INTRODUCTION

Capacitive Discharge Ignition (CDI) [1],[2]have been widely used for internal combustion engines[3] to power majority of motor vehicles and other internal combustion engines [3]. In a CDI system, a charging circuit at first charges a high voltage capacitor, and at the moment of ignition the charging of the capacitor is stopped by the ignition control system and the capacitor is allowed to discharge its output to the ignition coil before the output voltage reaches the spark plug.

A general CDI module [4] is composed of a small transformer, circuits for the purpose of charging capacitor, and generating triggering pulses and a voltage capacitor. A power supply included in the CDI module initially raises the system voltage from 250 to 600 volts and charges the capacitor. The rectifier inside the charging circuit prevents capacitor to discharge before the moment of ignition. The triggering circuit thereafter stops the operation of the charging circuit and the capacitor discharge through a low inductance ignition coil. The voltage output to for the purpose of ignition from spark plugs [5] depends on the design of the CDI Module. The charging circuit is thereafter connected again to charge the capacitor if there is no triggering signal. The time for charging in CDI system is relatively short with a voltage rise (between 3 ~ 10 kV/μs) compared to typical inductive systems (300 ~ 500 V/μs) and a short spark duration limited to about 50-80 μs.

1.1 Types of CDI Module

There are majorly two types of CDI modules: 1) AC-CDI and 2) DC-CDI.

Small engine ignition systems as in two-wheelers generally use DC-CDI module. The DC-CDI module is powered by a standard vehicle battery, and an inverter circuit is included in the general CDI module to raise the potential from 12 V DC to 400-600 V DC. The automobiles that have DC-CDI systems have more accurate ignition timing [6][7][8][9] and even in cold weather the internal combustion engines operate better compared to those with AC-CD systems [10].

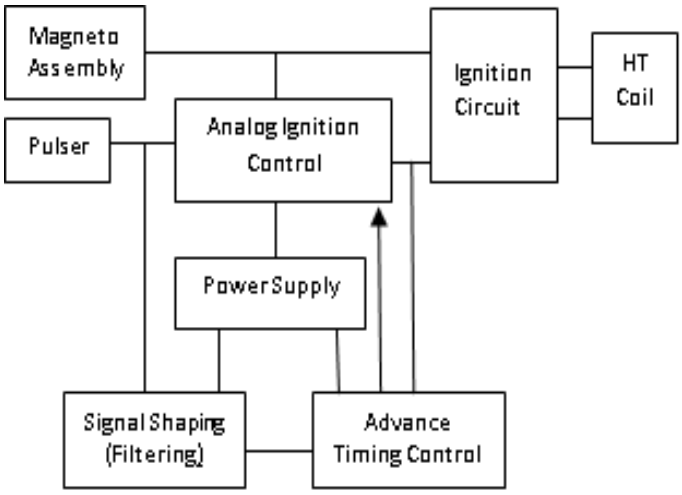

Fig-1: Block Diagram of Digital CDI Module [6]

Ignition key [11] is used to turn the switch that connects the battery to the ignition system [12]. Once the connection is established between battery and CDI system, the voltage capacitor is charged, and at the instant of ignition, the charging circuit stops charging the capacitor. The output from ignition capacitor is thereafter allowed to discharge through ignition coil before it reaches the spark plug in order to generate spark.

The paper has been split into multiple sections. In Section II and III, the design of the proposed embedded system is introduced as block diagram and flow chart of the embedded system. In sections ahead, the application area of the embedded system, advantages and limitations have been brought to notice and the results of the research have been discussed before conclusion.

2. BLOCK DIAGRAM

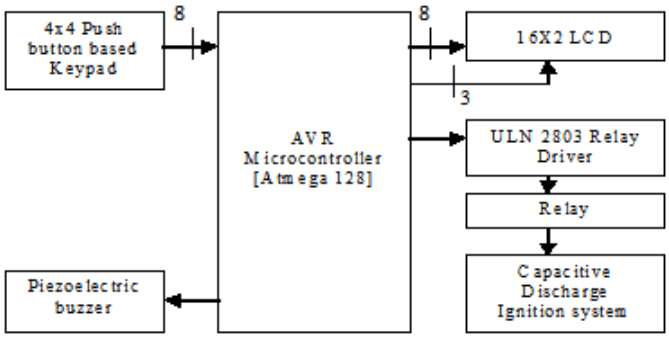

Fig-2: Block Diagram of Security enabled CDI System

The embedded system has password based login interface to allow user to turn on the ignition at the desired time. The four digit password can be entered through 4x4 matrix keypad designed using push buttons and if wrong password is inserted over and over and the instances of entry of wrong password exceed three then the piezoelectric buzzer alerts people present in vicinity of the vehicle. To serve the purpose of microcomputer unit AVR microcontroller Atmega 128 has been used in the embedded system which has 64 pins with 53 input/output pins and operates at the frequency of 16 MHz. If correct password has been entered then character LCD displays the login confirmation and thereafter indicates the turning on of the ignition system. The 12V relay is turned on by the relay driver after correct password has been entered which ensures turning on and turn off the ignition system.

After the ignition system[6] is turned on a the voltage capacitor is charged, and at the moment of ignition the ignition system stops charging the capacitor, the output from ignition capacitor is thereafter allowed to discharge through ignition coil before it reaches the spark plug in order to generate spark. Ignition coil ups the voltage from 220 V to 20000 V and provides the high voltage supply to spark plug.

3. FLOW CHART/ALGORITHM

The algorithm for the working of the designed embedded system is as follows:
A request is made to the user to enter the password using push button based keypad. If there is an instance of entry of wrong password then the user is asked to re-enter the password. If the instances of wrong password exceed three, then the buzzer is blown for a limited time period to issue alert to the people present in vicinity and to the owner of the vehicle. Else the relay driven by the relay driver establishes the connection of vehicle battery with the rest of the capacitive discharge ignition circuit.

The voltage capacitor is charged, and at the moment of ignition the ignition system stops charging the capacitor, the output from ignition capacitor is thereafter allowed to discharge through ignition coil before it reaches the spark plug in order to generate spark. Spark for the purpose of ignition is generated by the spark plug if the relay connects the ignition system to the battery.

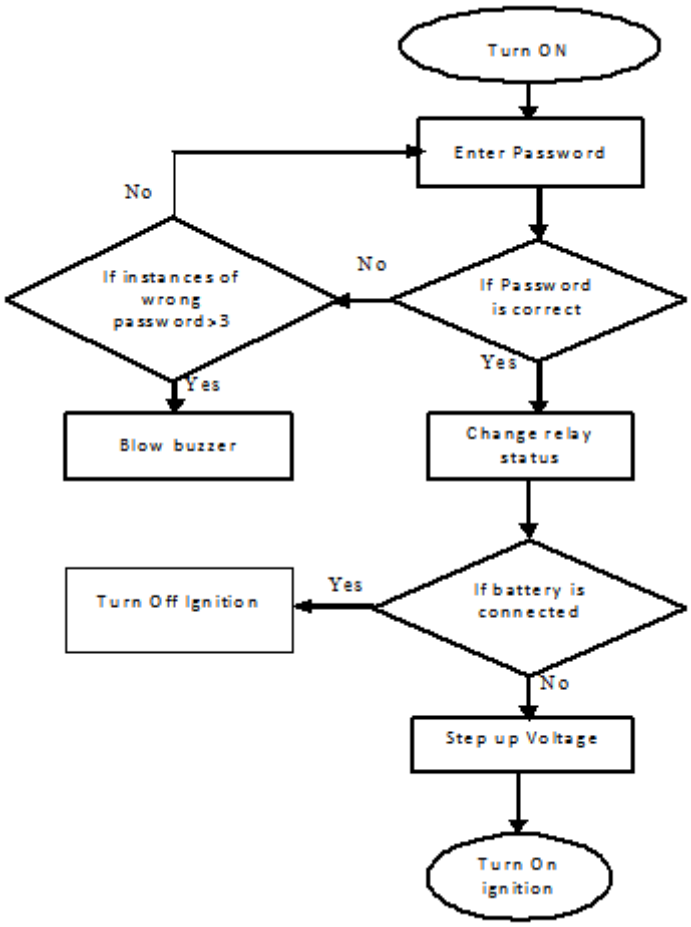

Fig-3: Flow Chart

4. PASSWORD IDENTIFICATION TECHNIQUE AND GENERATION OF MESSAGE AFTER WRONG ENTRY

A four digit password is assigned for turning on the ignition system. If the digits entered are incorrect order or different digits are entered then the CDI system is not turned on else the relay driven by the relay driver establishes the connection among the standard vehicle battery and the rest of the capacitive discharge ignition circuit and thus ignition system is turned on.

One exceptional case is if whole of the password is not entered or more digits are entered instead of four digits then even if the rest of the digits match to that of the assigned password then the status of the ignition system remains unchanged and the user is asked to re-enter the password.

5. APPLICATION AREA

The ignition key is still required even after the keyless entry has become a standard in most of the cars and motor vehicles. Embedded system with proposed designed in this

paper aims at replacing the function of ignition key to connect the battery to the rest of the ignition key and thereafter turn on the ignition. The password based initiation of ignition as in the newly designed embedded system finds a good scope in vehicular and automobile electronics and in safety enhancement. It may prevent instances of thefts of vehicles and easier access to the vehicles without the need of ignition key for the sake of initiating ignition while being in traffic.

6. ADVANTAGES AND LIMITATIONS

The newly designed embedded system aims at making the access to a motor vehicle completely keyless with higher security and ease. In order to enable the frequent turning on of ignition system has to be allowed by a push button based initiation of ignition instead of requesting for password entry every time. Thus the password entry has to be overridden at few instances for the sake of easiness.

7. RESULTS

Following are the embedded user interface as designed in the embedded system.

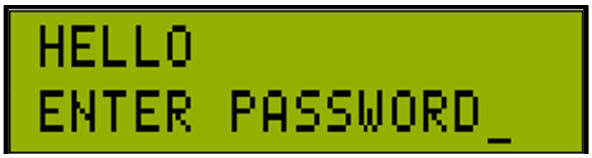

Fig- 4: Interface screen 1

Fig-5: Interface screen 2

Fig- 6:. Interface screen 3

The user interface is displayed as the LCD screenshots. The user interface in the form of 16x2 character LCD displays the request for the entry of password as in figure 4, message for initiation of ignition after correct entry of password as in figure 5 and indication of wrong entry of password as in figure 6.

8. CONCLUSIONS AND FUTURE SCOPE

The embedded system thus designed can ease and secure the manner in which internal combustion engine is turned on. The designed embedded system may prevent thefts and mishaps.

There is future scope for the designed embedded system with improvement in password retrieval system and designing of a password manager for the sake of altering the password from time to time by storing it in EEPROM.

ACKNOWLEDGEMENTS

I am deeply grateful to professors, other faculties and staff of Department of Electrical, Electronics & Communication Engineering of ITM University, Gurgaon by whose support I was able to complete my research work in time and unperturbedly.

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BIOGRAPHIES

Manish Kumar Chauhan is currently Post Graduate student in Masters of Technology, Embedded Systems from ITM University, Gurgaon. He completed his B.Tech in Electronics and Communication Engineering from Engineering College Ajmer, Rajasthan Technical University Kota in 2012. His area of interest is Embedded System Design and Real Time Systems.

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