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DESIGN AND IMPLEMENTATION OF A LOW-COST VEHICLE IGNITION DEACTIVATION SYSTEM

Akanni, A. A., Ajah, O. N., Agelebe, O.G., Orimogunje, O.K., and Olalude, A.O.
Department of Computer Engineering, Federal Polytechnic Ede, Osun State, Nigeria.
*abideenamosa@gmail.com

Abstract: This paper discusses the design and implementation of a low cost Vehicle Ignition Deactivation System capable of deactivating the ignition coil of a vehicle after 5 minutes of its theft. The designed system consists of hardware and software modules. The hardware module is made up of sub-modules: power supply, microcontroller (Arduino), transmitter (RF hand held remote control), the receiver, LED, Sensor, Relay, Voltage regulator (LM7805), while the software module consists of a set of command used to activate and deactivate the vehicle which employs C programming language. The transmitter is placed in the driver's pocket while the receiver is installed inside the vehicle. A tuned radio frequency (RF) signal is sent from the transmitter to the receiver through the RF decoder IC, the signal is decoded and sent to the microcontroller. The microcontroller output a signal to the relay that activates and deactivates the ignition coil of the vehicle after 5 minutes of its theft. The designed system was tested and its performance was satisfactory.

Keywords: Deactivation, Microcontroller, Receiver, RF decoder, Transmitter, Vehicle ignition.

1.0 INTRODUCTION

Security is the standard of safeguarding against endangerment, deprivation, or any culprit pursuit and a state where one can advance spontaneously [1]

For several years and even presently, vehicle theft has been the order of the day globally and because of this, Vehicle security system, no doubt, has become one of the major requirements for vehicle owners [2][6]. Yearly, thousands of vehicles are stolen while thousands are recovered by police when the thieves are caught or when thieves abandon the stolen vehicle after being used [3]. Vehicle theft has been one of the most expensive property crimes in present civilization and has been on the increase these days, and this has spurred the creation of anti-theft systems [4][5]. Several types of security systems exist presently with various degrees of sophistication, complexity and cost [1].

Notwithstanding, commercially available Vehicle anti-theft devices are costly, therefore there is the need to come up with a system that will perform same function without compromising the effectiveness and efficiency, hence the design and implementation of a low cost Vehicle Ignition Deactivation System. It is capable of deactivating the Vehicle ignition system 5 minutes after its theft and stop the vehicle.

2.0 MATERIALS AND METHOD

The designed system involves hardware module and software module. The hardware module is made up of sub-modules: power supply, microcontroller (Arduino), transmitters (RF hand held remote control), the receiver, LED, Sensor, Relay, Voltage regulator (LM7805), while the software module consists of a set of command used to activate and deactivate the vehicle which employs C programming language

Power supply Unit

The microcontroller and other hardware components are powered by a +5V DC, regulated voltage supply. The car battery supplies a minimum voltage of 12V which is high enough to damage the microcontroller therefore there is a need to regulate it and maintaining a stable DC output voltage of 5V. This is achieved using LM7805 voltage regulator.

Processing Unit

The designed system utilizes a microcontroller (Arduino) which is the heart of the design. It receives the input from the decoder IC and sends signal to the relay that activates and deactivates the ignition coil**.**

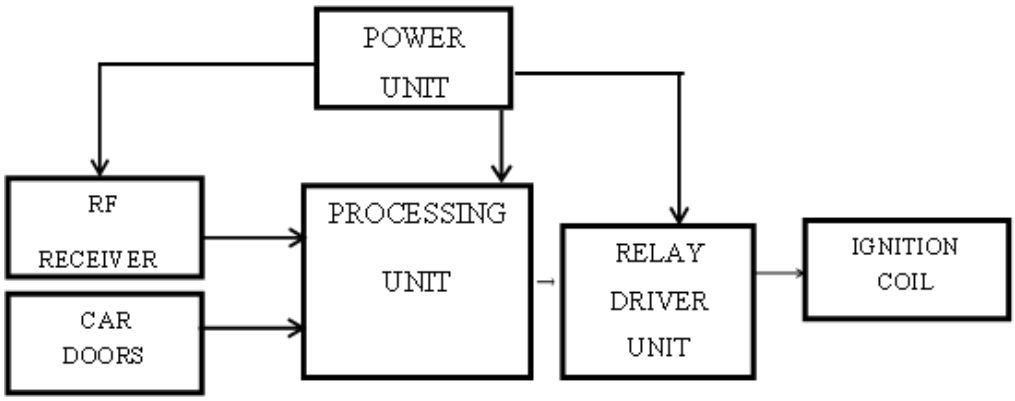

Figure1: Block diagram of the designed system.

Relay Driver Unit

This unit consists of a Relay and a transistor. A relay is used as a switch which acts as an interface between the electronic circuit and mechanical circuit. The unit switches off/on the ignition coil. When the stop button is pressed on the remote control or any of the doors is opened and closed, the microcontroller will send a logic high to the base of the transistor via the base resistor and the transistor will switch the relay while the relay will in turn cut-off the connection of the ignition coil and the vehicle stops.

LM7805 Voltage Regulator

The LM7805 voltage regulator is a fixed linear voltage regulator integrated circuit (IC). It belongs to the family of the 78xx. The xx is output voltage. The 7805 has an output voltage of 5v [7]. The features of 7805 voltage regulator are: 3-terminal regulators, output current up to 1.5A, internal thermal-overload protection, a high power-dissipation capability, internal short-circuit current limiting, output transistor safe-area compensation.

RF Transmitter and Receiver

The RF module, as the name suggests, operates at Radio Frequency. The corresponding frequency range varies between 30 kHz & 300 GHz. In this RF system, the digital data is represented as variations in the amplitude of carrier wave. This kind of modulation is known as Amplitude Shift Keying (ASK) [8]. This RF module consists of a RF Transmitter and a RF Receiver. The transmitter/receiver pair (Tx/Rx) operates at a frequency of 434 MHz and an RF transmitter receives serial data that transmits the signal to an antenna connected at pin 4 wirelessly through RF. This transmission occurs at the rate between 1Kbps and 10Kbps. The transmitted data is received by a RF receiver operating at the same frequency as that of the transmitter[8].

Remote control using RF module

An RF remote controller is a device that can be used to switch ON/OFF equipment or devices wirelessly using radio frequency transmission. The remote or transmitter part is a handheld device that has switches or other input options to select the operation. At the receiver side, it executes the operation like switch ON/OFF as per the data of the transmitted signal [9]. Compared to infrared remote controls RF remotes have a longer operating range and even it doesn't need a line of sight between the transmitter and the receiver.

Receiver Unit

This unit consists of RF receiver module and the HT12D decoder IC. The primary function of HT12D is to decode the 12-bit that is received by the input pin. Whenever a signal is detected by the RF receiver module, it is sent to the input pin of the IC. The signal is decoded by the IC into 12-bit (4-bit data and 8-bit address).

The Software module

The software design of the project consists of writing a computer program for the Arduino through an Arduino Integrated Development Environment (IDE) to implement the desired vehicle lock system. This includes the program codes to implement and interface and the various sub-units of the system with the Ardunio. Basically, the programs are written in C language.

3.0 PRINCIPLE OF OPERATION

The system as developed makes use of an RF transmitter module that can transmit an RF signal to an RF receiver module. For RF communication to be established, the two modules cooperate. While the receiver is

mounted inside the car, the hand-held transmitter can be kept in the driver's pocket. When a button on the remote control is pressed, a radio frequency (RF) signal tuned to that particular frequency is transferred from the transmitter to the receiver through the RF decoder IC.

The signal is then decoded and sent to the microcontroller for processing. The relay that turns on and off the vehicle's ignition coil after five minutes of theft receives an output signal from the microcontroller. When a button on the remote control is pressed, the microcontroller then reads the signal and gives the desired output. The microcontroller uses C language programming code to coordinate communication between the RF transmitter and receiver.

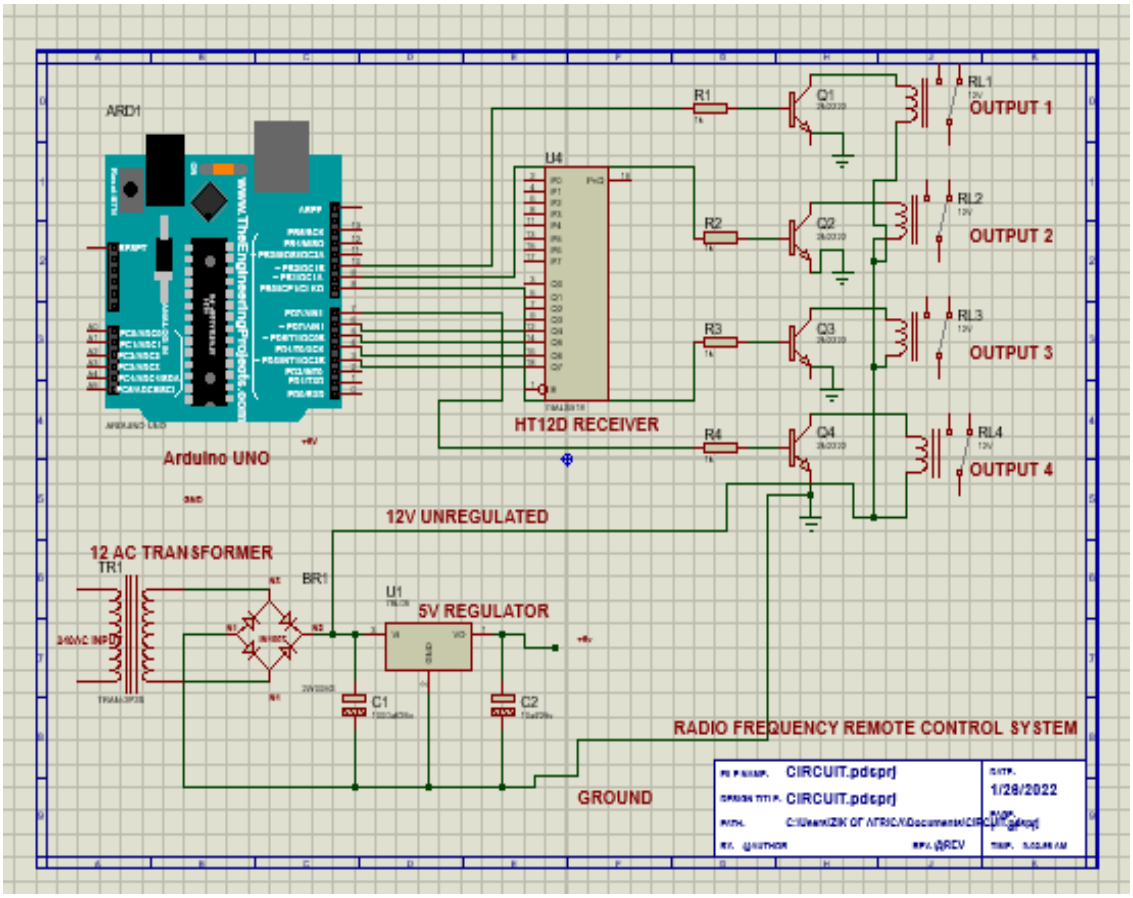

Figure 2: Circuit Diagram of the designed system

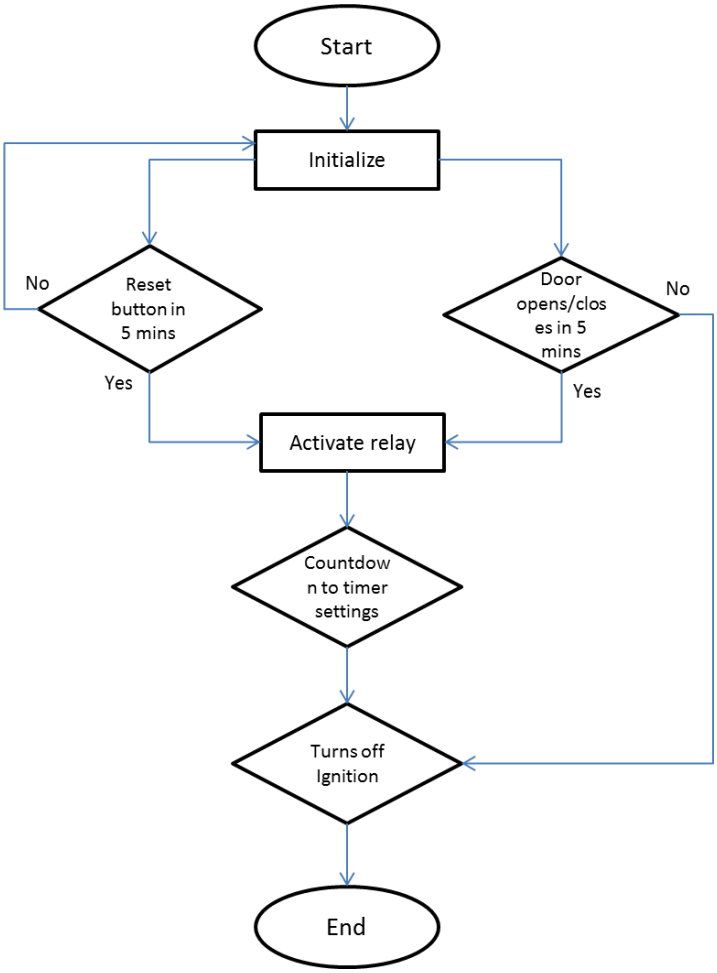

Figure 3: Flowchart of the designed system

Software Algorithm

Start the system
Initialize the system; if reset button is pressed, the relay is switched OFF
Else if the stop button is pressed the system will not be initialized
If the door is opened, switched ON the relay
Deactivates the vehicle Ignition.
Stop

4.0 RESULTS AND DISCUSSION

On the gadget, there are five buttons (four were used in place of the vehicle doors and another one for the reset). The ignition coil was deactivated after 5 minutes when the system was turned ON and one of the four buttons was touched. The ignition coil was then turned on once more after pressing the reset button. On the remote control, the same test was run. Two buttons are present on the remote control (Lock button and the Reset button). These two buttons were tested at a distance of no more than 100 meters, and they responded as expected. The end outcome was satisfactory when the system had been fully designed. The system is trustworthy and effective, according to the test findings.

The summary of the test outcomes when the remote control was pressed is shown in Table 1 below (the lock button, the door button and reset button). The relay turns on and the green LED illuminates when the lock button is pressed. Any of the door buttons could be pressed and then released to turn on the relay and turn on the green LED. Finally, the green LED turned off and the relay turned off when the reset button was pressed.

Table 1: Test results from the designed system.

Action Taken	Tim Elapsed	Distance of RF device to Vehicle	Relay Status	Radio/electromagnetic Wave Frequency	Ignition Status
Door lock	< 5 mins	< 100m	Activated	30 – 98 MHz	On but counts down
Cut Ignition	< 5 mins	< 100m	Activated	30 – 98 MHz	On but counts down
Reset	< 5 mins	< 100m	Activated	30 – 98 MHz	Turns off Ignition
Door lock	> 5 mins	> 100m	Activated	30 – 98 MHz	Turns of Ignition
Cut Ignition	> 5 mins	> 100m	Activated	30 – 98 MHz	N/A
Reset	> 5 mins	> 100m	Activated	30 – 98 MHz	Resets to initial state

Plate 1: Pictorial view of the whole system.

Plate 2: Pictorial view of the remote control.

5.0 CONCLUSION AND RECOMMENDATION

Conclusion

The aim of this study is to design and implement a low cost Vehicle Ignition Deactivation System, this has been achieved. Though the device cannot indicate the location of the vehicle but provides security for the vehicle by deactivating its ignition after 5 minutes of its theft and stop the vehicle.

6.0 Recommendations

For the improvement of the designed system, it is therefore recommended that an alert or alarm system should be incorporated for theft notification and an effective tracking system should be added to the device, this will allow the owner to locate the vehicle on time.

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