

## Intelligent Automobiles Diagnostic System

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**Abstract:** The goal of smart or intelligent car diagnostics systems is to provide access to car problems more accurately and easily than traditional systems, and there is a group of drivers who do not know the timing of the periodic diagnosis of the car, for example (when to change the spark plug or change different types of filters), and when the driver does not pay attention to the importance of the periodic maintenance schedule, malfunctions occur at random times, for example, if an engine problem occurs and the maintenance team is unaware of the problem, other issues may arise when the Check Engine light illuminates. This paper aims to eliminate all of these issues by sending notifications to the driver's mobile phone about the time of periodic maintenance for each piece, which can be for the allowance after a certain time or some distance, and changing the driver in the event of an engine problem and how to maintain it. It was found that the suggested system is efficient in decreasing sudden damage occurred in automobiles system by providing on time messages and warnings to the driver about systems need maintenance which enhances the preventive maintenance of automobiles.

**Keywords:** *Intelligent, diagnostic, maintenance, automobiles, mobiles.*

### 1. Introduction

The quality of vehicle maintenance and repair directly affects the length of service (life), the durability of the vehicle and its fuel consumption, as well as general road safety. For example, when the air pressure in the wheels drops by 20%, the fuel consumption rises by 10%. As a result, the manufacturer's standards and instructions must be followed in order to extend the life of the vehicle and maintain its operational readiness. Types of maintenance systems: The primary goal of vehicle maintenance is to keep it ready to work in all conditions and to reduce the occurrence of unexpected malfunctions by performing diagnostic, tension, and calibration work [1]. The primary goal of vehicle repair is to restore them to working order by replacing worn, damaged, or broken parts that the vehicle cannot operate without. In order to reduce corrosion to the lowest possible level in the vehicle's parts and systems, programmed maintenance must be performed after the vehicle has run to some specified distance for that or working hours, whereas repair is performed on demand when malfunctions appear during the vehicle's operation or during diagnostic and maintenance operations. Usually maintenance and repair operations are programmed according to the distance (km) that the vehicle travels or the working hours assigned to it

to ensure maximum safety conditions on the road and to maintain the vehicle's readiness to work [1-4].

### Artificial intelligence in diagnosis

This paper provides a brief introduction to artificial intelligence in the diagnostic process of car faults and Automotive Remote Diagnostics. Automotive remote diagnostics is a system that uses a wireless network to monitor vehicles. Vehicle performance is typically monitored by analysing real-time data from specific parameters. The evaluation aids in identifying any deviations from the expected performance. The vehicle's diagnosis is based on real-time vehicle data associated with several parameters of vehicle performance, as well as the identification of root causes of deviation. This aids in the most accurate diagnosis of the problems at hand [2].

Among the benefits of incorporating artificial intelligence into diagnostic processes are the following: saving time and effort by facilitating the driver's fault diagnosis process, allowing the driver to know when to switch the buckle, skims, and brakes, contributing to the efficiency of the fault diagnosis process, and accurately identifying faults rather than changing or examining more than one item in the vehicle [2].

Tayem (2011) used a variety of knowledge representation formats to design and build an intelligent database system for automobile problem diagnosis. By utilizing a relational database, the knowledge representation scheme employs both procedural and declarative knowledge representation formalisms. As a result, the rule base, case base, and frame base formats were converted to tables.

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The technique allows for the use of forward and backward chaining reasoning, the issue reduction method, and the heuristic search strategy to answer questions. All of the system's editing capabilities are available, including the ability to insert, remove, and change rules, cases, and frames. Visual Studio 2008 (VB.Net) was used for system implementation and proper user interface design. The implementation is a system application in the domain of vehicle fault diagnosis. As a result, the Intelligent Database System for Vehicle Fault Diagnosis was tested for a large number of cases, and the results from various cases matched the results of the vehicle mechanic [5]. Cross-linking, according to Selig et al., influences the diagnostic technique (2012). As a result, this paper describes a novel diagnostic strategy for automotive mechatronic systems. The goal is to monitor communications sent over automotive communication systems such as the CAN bus. The messages on the bus, according to the authors' assumption, alternate between immaculate and unsatisfactory vehicle condition. Messages sent by sensors and control units differ depending on the vehicle's state. The preliminary experiments are carried out, and the hardware design of a suitable diagnostic interface is provided [6]. Lanigan et al. (2011) searched the technical literature for failure diagnostic approaches appropriate for the emerging class of distributed, embedded control-systems for vehicle comfort, safety, and autonomy. The primary fault models,

failure consequences or manifestations, fault injection processes used in the design and evaluation of the safety system, failure diagnostic requirements, and, finally, real failure diagnosis methodology will be addressed in this investigation [8]. Singh et al. (2021) described the advancements and developments of the Internet of Things in the automotive industry in order to build an intelligent diagnostic system based on IoT [7].

## Intelligent diagnosis

### -Data Capturing and data preparation

The acquisition system in the vehicle is in charge of collecting the appropriate vehicle data during data capture. Individual measurement values available in the vehicle can be stored as local data using a configuration. The acquisition system's system requirements are reduced so that it can run flawlessly on a vehicle's embedded platform. To transfer the collected data to the cloud for further analysis, either a connected gateway (GW) or a powerful vehicle communication interface (VCI) is used. This transaction is based on widely accepted communication standards and Transport Layer Security (TLS) encryption technology, which significantly improves the stability of unreliable Internet connections. [3]. One example here is Software Update over the Air (SOTA)-figure 1 [3].

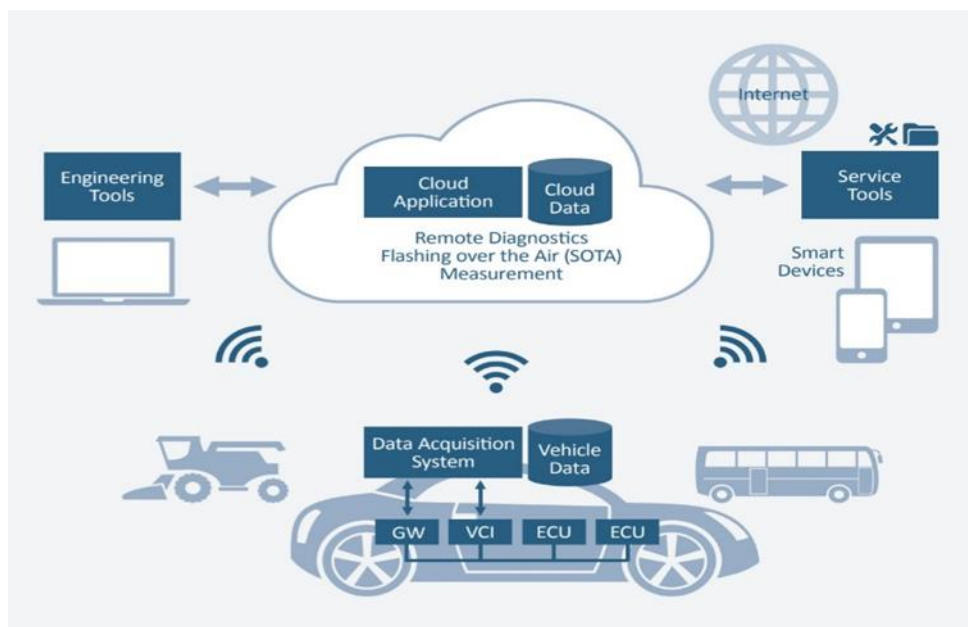


Fig. 1. Data Preparation [3].

## 2. Material and Methods

Figure 2 shows the suggested Block diagram of the system.

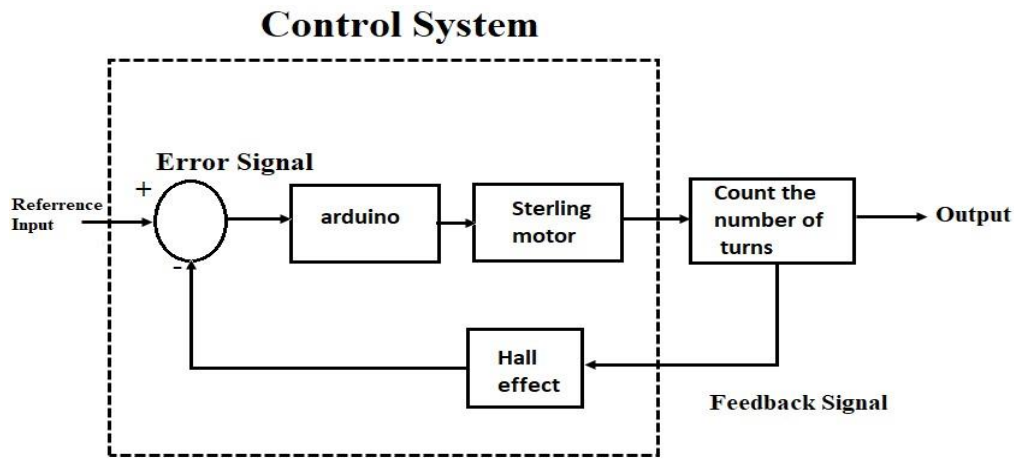


Fig. 2. Block diagram.

The (Block diagram) contains: control algorithm, actuator, probes and sensor (feedback)

1. Control: Arduino
2. Actuator: sterling motor
3. Probes : count the number of turns
4. Sensor: hall effect sensor.

Here is a brief explanation of each part.

#### Control an Arduino with Bluetooth:

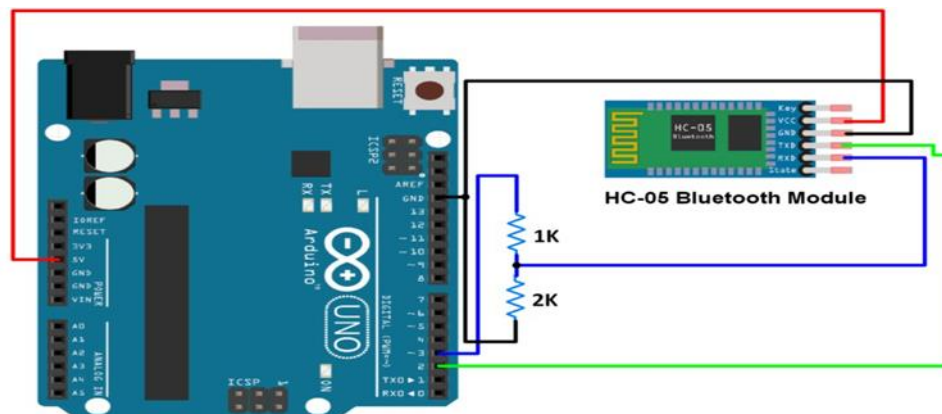


Fig. 3. Connection Bluetooth with Arduino.

Some of Arduino Pins | Bluetooth Pins are:

- RX (Pin 0) → TX
- TX (Pin 1) → RX
- 5V → VCC
- GND → GND [6].

#### • Requirements:

- An Arduino
- Any model of the Arduino can be used.

A Quick Overview of Bluetooth Communication and Protocol. Wireless communication protocols include NRF, ZigBee, Wi-Fi, and Bluetooth. Bluetooth protocol: an inexpensive communication method in a PAN network, with a maximum data rate of 1Mb/S and a nominal range of 100 meters using 2.4 G frequency is a common way of wireless communicating. The HC05 module is a Bluetooth module that uses serial communication and is commonly used in electronics projects.

Some of HC05 Bluetooth module important specifications is its Working voltage: 3.6V – 5V and internal antenna as shown in figure 3 [5].

-An Android Smartphone with Bluetooth

Check if your phone has Bluetooth by navigating to "Wireless and Networks" under settings.

-HC-05 Bluetooth Module

This module is the most popular Bluetooth module out there. The basic version is pretty inexpensive. The hassle of having to connect wires between the module and the Arduino can be avoided by using a Bluetooth Shield or a version in the Bee shape, the BTBee and a Bee shield.

-USB cable for the Arduino

Table 1 shows the suggested messages appears when travels specified distance.

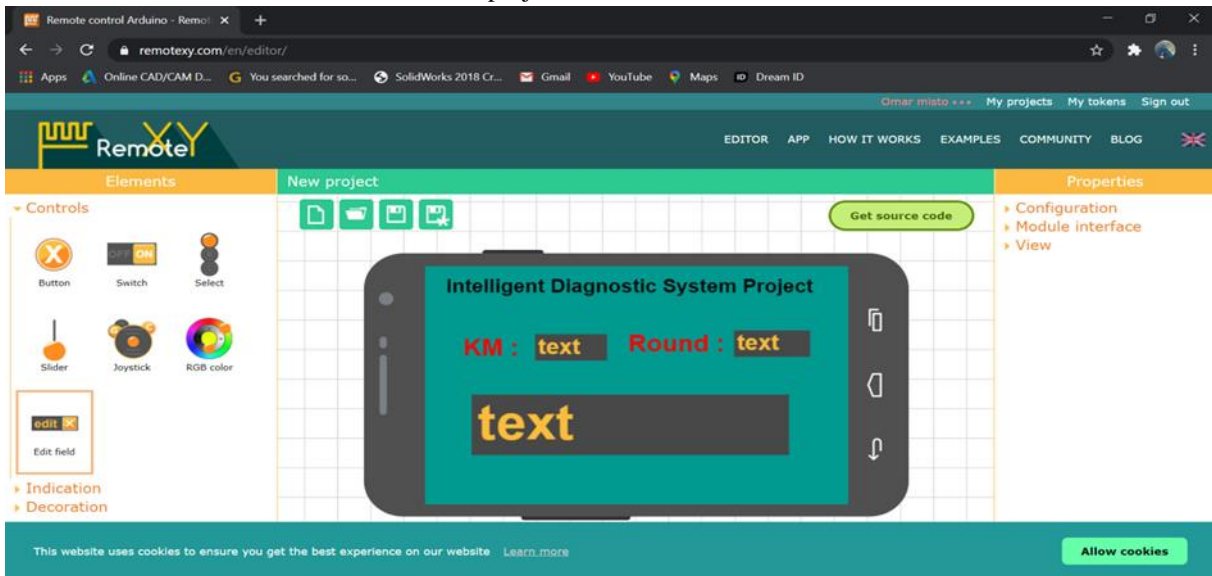
**Table 1.** The messages appears when travels specified distance.

The traveled distance $\times 10^3$ km	The message
5	Engine Oil need to change
17	Spark Plug need to change
22	Air Filter need to change
48	Break need to change
53	Fuel Filter need to change
72	Timing belt need to change
89	Gear Oil need to change
178	Wheel need to change

**-Built the system and circuits**

The system was built completely and write the code for the Arduino circuit, and the system worked according to the data giving. An application on the computer that includes the engine speed and the number of revolutions per minute is used here as shown in figure 4. From the previous data the application gives messages to alert the driver about the faults that we have included in the project

which is: the spark plugs, the brake, the timing belt, the Tire wear, gasoline filter, air filter, transmission oil (gear oil) and finally Engine oil. To facilitate the process of diagnosing the malfunction for the driver and knowing the malfunction before it happens and it is very useful in preventive maintenance and in periodic maintenance. The messages issued from the application was with the data and the results were identical [9-10].



**Fig. 4.** Website building mobile application online.

**3. Result and Discussion.**

Currently reviewing some tests and results of applying the system on some test car. Engine oil need to change (as shown in figure 5) is the message appears when the engine needs to change the oil every 5000 km and in the code the

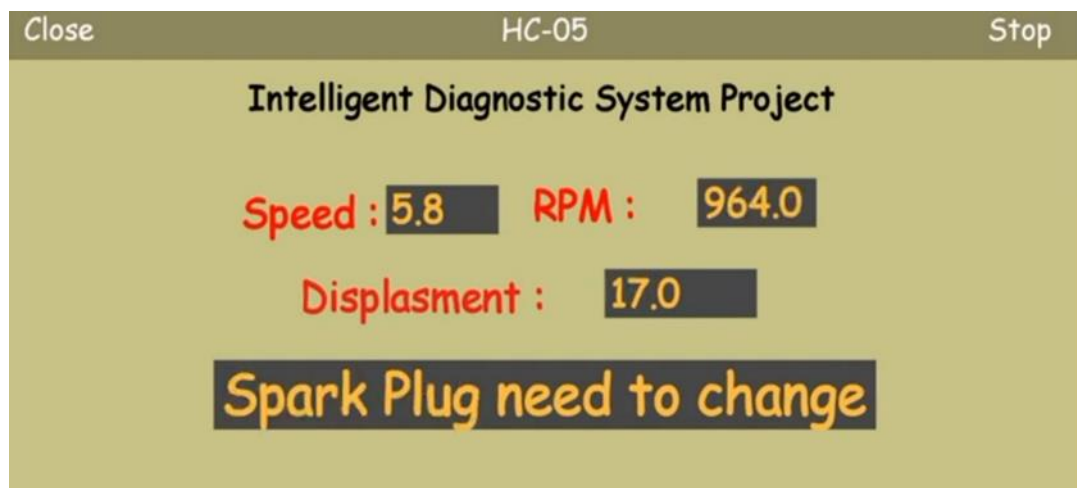
distance value is the actual value divided into 1000 and changing the oil is one of the most important things in the periodic maintenance when the viscosity of the oil changes or the amount of oil decreases and the oil works To reduce the friction between moving parts in the engine.



**Fig. 5.** Screenshot for the one test.

Spark plug need to change: The second message (Spark plug need to change-Figure 6) and this message appears when the distance travelled reaches 17000 km and in the code the distance value is the actual value divided into

1000, which is the estimated distance to change the spark plug, and it is one of the most important things in periodic maintenance and its function is to give a spark to the completion of the combustion process.



**Fig. 6.** Screenshot for the second test.

Air filters need to change: the third message (Air filter need to change- as shown in figure 7) and this message appears at a distance of 22000 km and in the code the distance value is the actual value divided into 1000, which

is one of the most important things in regular maintenance and the function of the air filter is to reduce the air from impurities and dirt.

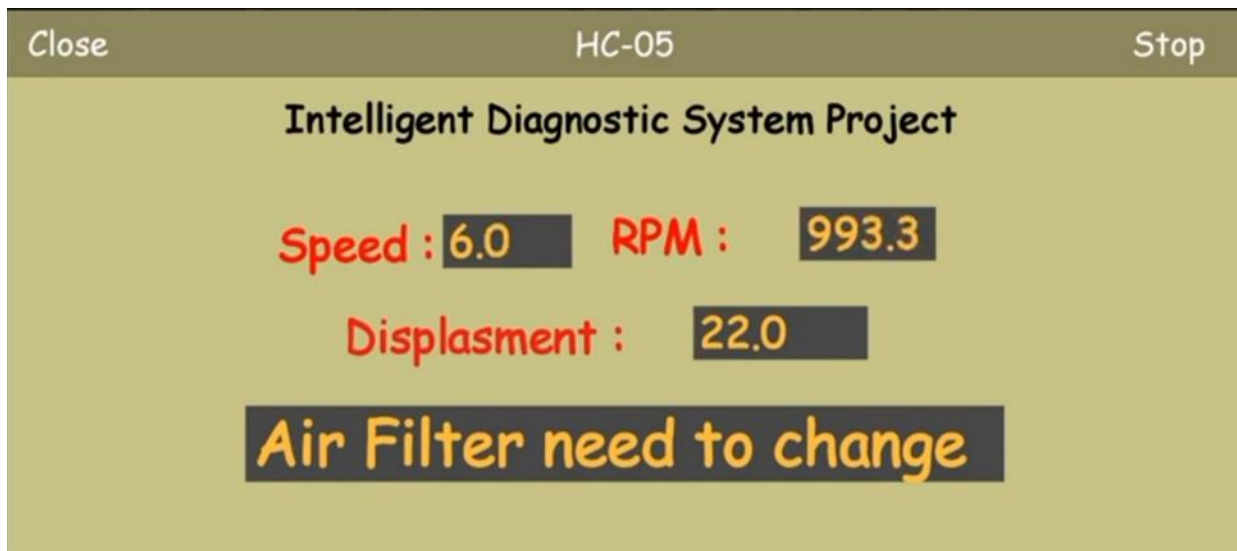


Fig. 7. Screenshot for the third test.

Breaks need to change: the fourth message (Break need to change-as shown in figure 8) This message appears when the brake needs to be changed at a distance of 48,000 km in the code the distance value is the actual value divided

into 1000. Changing the brake is one of the most important things in regular maintenance as the brake function is to assist in braking the car. And reduce its speed.

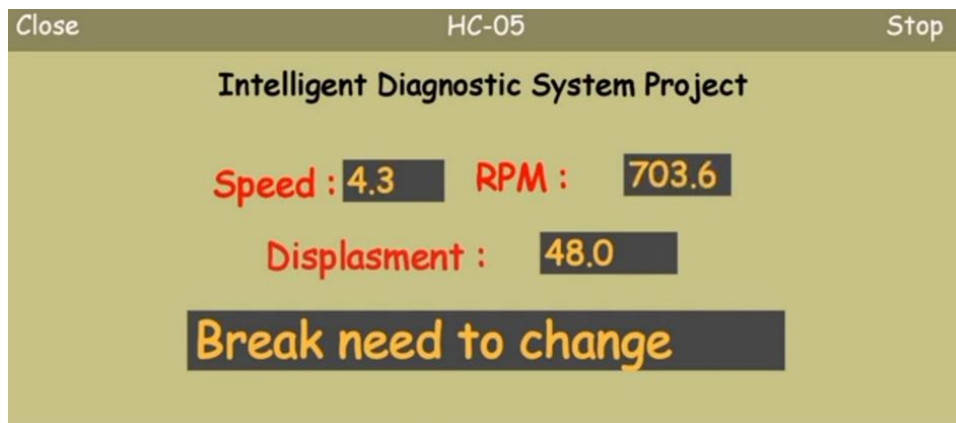


Fig. 8. Screenshot of the fourth test.

Fuel filter need to change: the fifth message (Fuel filter need to change-as shown in figure 9) and this message appears at a distance of 53,000 km in the code the distance

value is the actual value divided into 1000 and the fuel filter works to reduce the impurities and dirt in the fuel before it enters the combustion chamber.

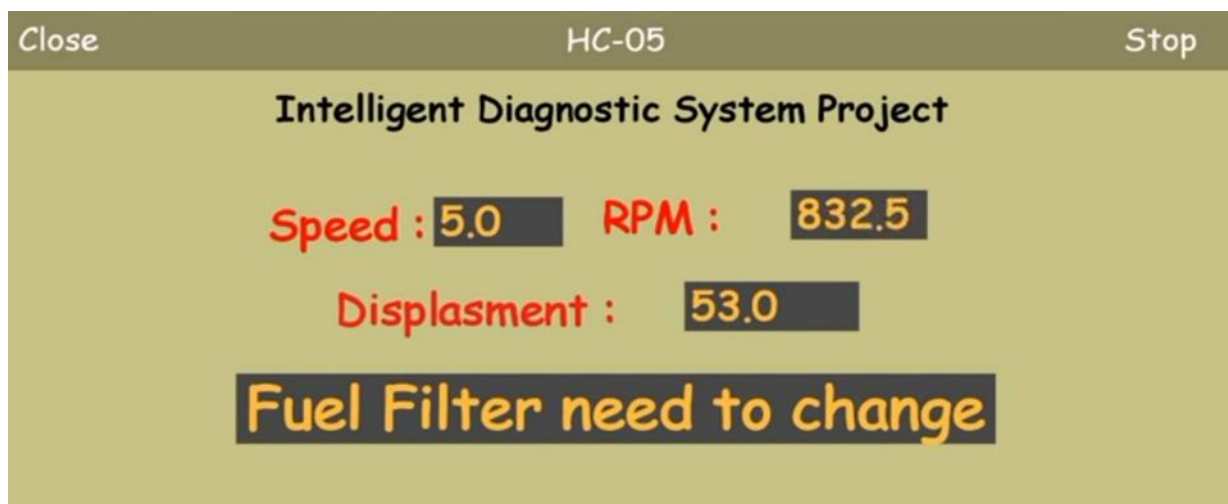


Fig. 9. Screenshot of the fifth test.

Timing belt need to change: The sixth message (Timing belt need to change) and this message appears at a distance of 72000 km in the code the distance value is the actual

value divided into 1000 and where you must change the timing belt and its function is to transmit the movement in the engine from the crankshaft. See figure 10.

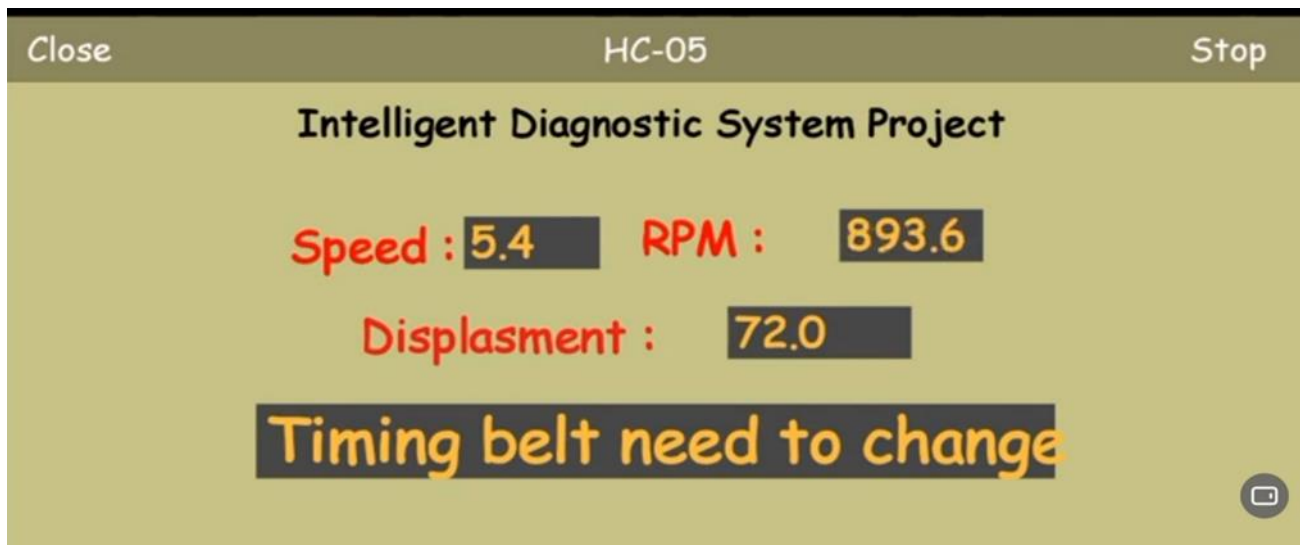


Fig. 10. Screenshot of the sixth test.

Gear oil need to change: The seventh message (Gear oil need to change-as shown in figure 11) and this message appears at a distance of 89,000 km in the code the distance value is the actual value divided into 1000 and the

function of the gear oil is to reduce the friction between the gear gears and it is one of the most important things in regular maintenance.

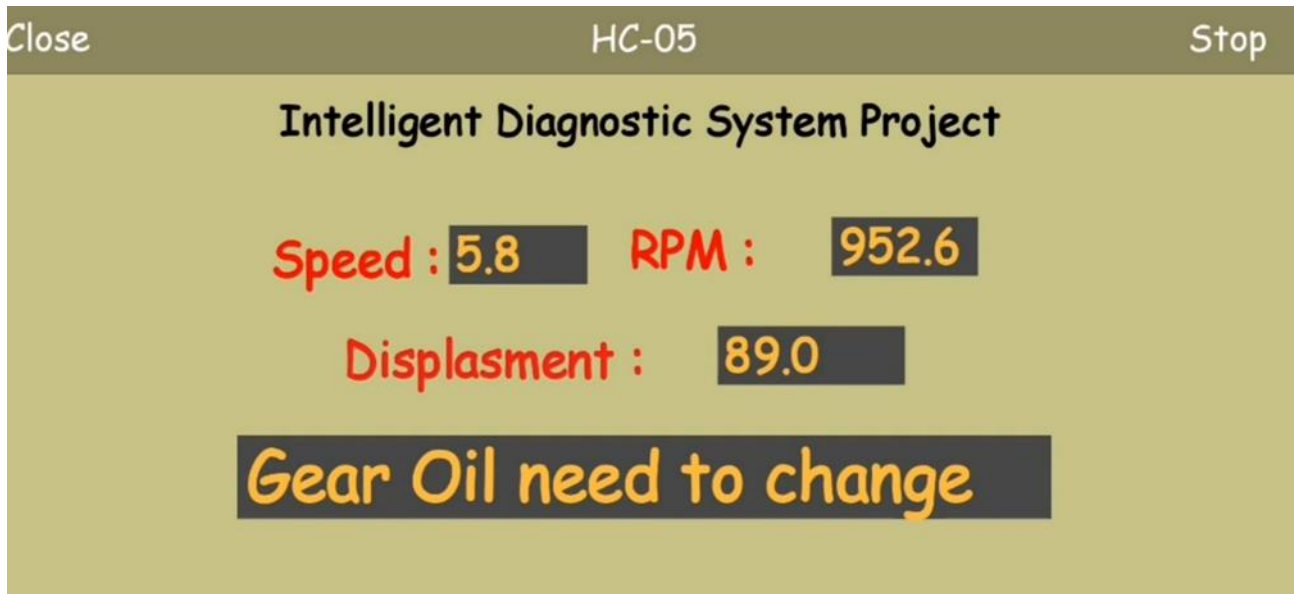
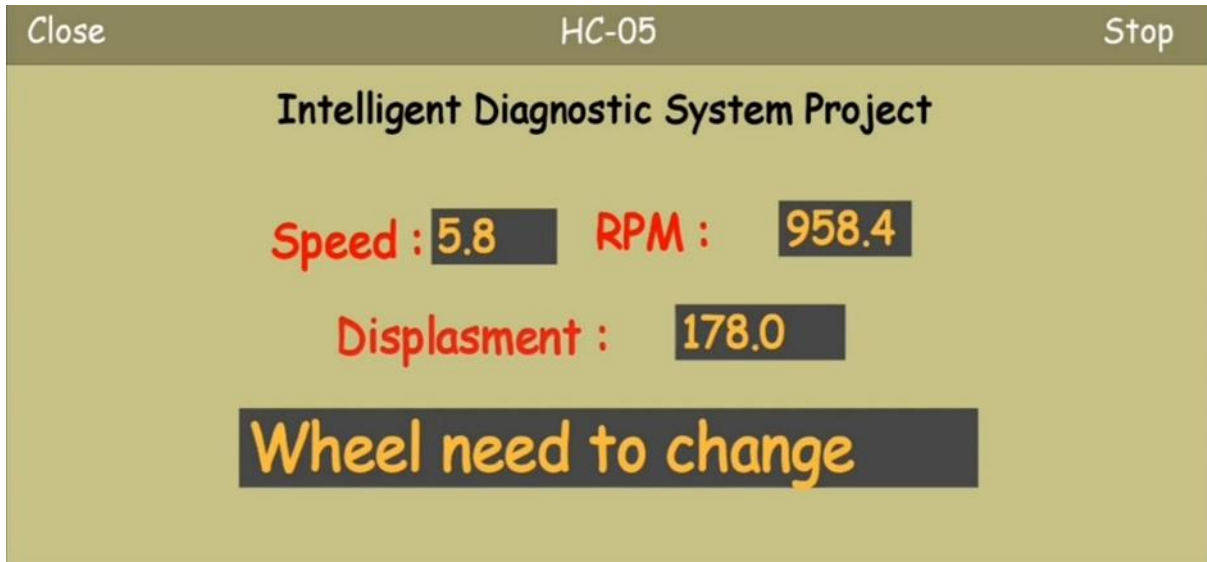


Fig. 11. Screenshot of the seventh test.

Wheel need to change: The eighth message (Wheel need to change-as shown in figure 12) and this message appears when the wheels need to be changed at a distance of 178,000 km in the code the distance value is the actual

value divided into 1000. Changing wheels is one of the most important things in periodic maintenance as not changing the wheels in a timely.



**Fig. 12.** Screenshot of the eighth test.

#### 4. Conclusions

In this paper an intelligent or smart diagnostic automobile system is constructed, this system provides the driver continuously by the status of the car and remind him with the preventive maintenance operations needed depending on the distance covered by the car. The spark plugs, the brake, the timing belt, the Tire wear, gasoline filter, air filter, transmission oil (gear oil) and finally Engine oil are some elements or system need to be changed or repaired in some specific times, the system sent a message to the driver to take care and repair such system as soon as possible. The suggested system is efficient in decreasing sudden damage occurred in automobiles system by providing on time messages and warnings to the driver about systems need maintenance.

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