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**COLLEGE OF COMPUTING, INFORMATICS AND MEDIA.**

**BACHELOR OF INFORMATION SYSTEMS (HONS.)**

**INTELLIGENT SYSTEMS ENGINEERING**

**ISP543 – KNOWLEDGE BASED SYSTEMS**

**PROJECT TITLE:**

**VEHICLE’S FAULTS DETECTION**

**PREPARED BY:**

|  |  |  |
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**1.0 INTRODUCTION**

Fixing a vehicle’s fault can refer to diagnosing and repairing a problem with a car, truck or other types of vehicles. This process always begins with identifying the symptom of the vehicle’s fault, such as leakage of fluid or an engine noise. Once the symptom has been identified, a mechanic will use diagnostic tools and their knowledge of the vehicle to determine the cause of problem. Once the root cause has been identified, the mechanic will repair or replace the faulty parts and test the vehicle to ensure that the problem has been resolved.

**1.1 PROBLEM STATEMENT**

Car maintenance and repair can be a daunting task for many car owners, especially when it comes to identifying and resolving issues with the engine, tire, brake systems and headlights. These systems are critical to the safe operation of a vehicle, and any problems with them can lead to costly repairs and even accidents.

Currently, car owners often rely on mechanics or repair shops to diagnose and fix problems with their vehicles. The current process of identifying and resolving issues with engine, tire, brake systems and headlights in cars is often time-consuming, expensive and can lead to misdiagnosis or overcharging.

**1.2 OBJECTIVES**

The expert system will be designed to be user-friendly and easy to use, and it will be able to diagnose a wide range of problems, including issues with the engine, tires, and brakes. The expert system will also be equipped with the latest knowledge and technologies to ensure that it can accurately diagnose problems with the latest vehicle models and technologies.

The goal of this project is to develop an automotive expert system that can accurately diagnose problems associated with engine, tire, and brake systems, and thus helping to improve the safety, efficiency, and cost-effectiveness of car maintenance and repair.

**1.3 SCOPE**

* The users need to determine which part of their vehicle are having problems whether it is the engine, brake, headlights, or tyres.
* This system will show what are the problems of vehicles to the users, and user can go to mechanic, at the same time know what are the problems that their vehicle is having, and could avoid any unnecessary repairs that have been suggested by the mechanics.
* If the problems are unsolvable by using the system, the system will advise users to go to the workshop and do manual inspection.
* This system only focuses on cars.

All car owners can use this system to identify the problem of their cars. The system can be accessed through a mobile app, allowing users to use it at any time and location of their choice.

**1.4 PROJECT SIGNIFICANCE**

By using this system, users are able to self-diagnose their vehicle’s problems and take appropriate action to fix the problem, such as scheduling a repair appointment at workshops or ordering replacement parts. Additionally, this system also can help users to understand the potential cause of the problem and the severity of the issue, which can help them to make more informed decisions about how to handle the problem.

**2.0 METHODOLOGY FOR KNOWLEDGE ACQUISITION AND REPRESENTATION**

**2.1 KNOWLEDGE ACQUISITION**

The process of acquiring new information or knowledge is referred to as knowledge acquisition. This can involve picking up new information, comprehending novel ideas, or gaining new abilities. Knowledge acquisition in the context of Artificial Intelligence and Machine Learning is the process of imparting new information to a machine or computer system so that it may make judgements or predictions based on that knowledge.

**2.1.1 Interview**

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**2.2 KNOWLEDGE REPRESENTATION**

Diagram

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By using a semantic network for knowledge representation, our domain's knowledge is represented. It contains all the data and facts required to build the knowledge base.

**2.3 INFERENCE TECHNIQUE**

we employed the Forward Chaining technique for inference. This approach proved to be an effective choice for our system, as it allows us to gather a significant amount of input from the user for Engine, Tyre, Brake, Headlight, and then display the corresponding results. The forward chaining strategy is particularly useful when the goal is to generate a large amount of output based on a given set of input. It starts with the available data and applies logical rules to deduce new information, this process continues until it reaches the desired output. This technique is well-suited for our system as it enables us to gather as much user input as possible and generate results in a prompt and efficient manner.

**ENGINE**

Diagram

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**BRAKE**

Diagram

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**TYRE**

Diagram

Description automatically generated

**HEADLIGHT**

Diagram

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**3.0 SYSTEM CONSTRUCTION AND DEVELOPMENT**

**3.1 DATABASE (LIST OF FACTS)**

**ENGINE**

F1: engine starts.

F2: engine not starting.

F3: runs normally.

F4: not runs normally.

F5: sluggish.

F6: not sluggish.

F7: misfiring.

F8: not misfiring.

F9: knocking.

F10: not knocking.

F11: engine not rotating.

F12: has gas.

F13: gas is empty.

F14: lean the fuel line.

F15: adjust point gap.

F16: change engine oil.

F17: take the car to mechanic.

F18: fill in the gas tank.

F19: change the battery.

F20: no repair needed.

F21: clean the fuel line.

F22: engine rotates.

**TYRES**

F23: tyres not inflated.

F24: tyres are punctured.

F25: tyres are not punctured.

F26: tyres aligned.

F27: tyres misaligned.

F28: tyres moving smoothly.

F29: tyres not moving smoothly.

F30: tyres vibrating.

F31: tyres not vibrating.

F32: tyres have dirt/mud.

F33: tyres don’t have dirt/mud.

F34: noisy sound from bearing.

F35: no noisy sound from bearing.

F36: get tyre Inflated.

F37: Get punctured repaired.

F38: apply oil in the axle.

F39: clean the dirt/mud.

F40: change wheel bearings.

F41: get tyres aligned.

F42: tyres inflated.

**BRAKE**

F43: brake pedals not hard.

F44: car unused for long.

F45: car not unused for long.

F46: Pedal squishy.

F47: Pedal not squishy.

F48: there’s leakage on fluid master cylinder.

F49: there’s no leakage on fluid master cylinder.

F50: car pull one side while braking.

F51: car does not pull one side while braking.

F52: rotors still thick.

F53: rotors not thick.

F54: Check for rusting near pedal.

F55: Repair leaking vacuum.

F56: Fix the leakage.

F57: replace the cylinder.

F58: Resurface rotors.

F59: replace the pads.

F60: brake pedals hard.

**HEADLIGHT**

F61: headlight not working.

F62: headlight dim.

F63: headlight does not dim.

F64: alternator is old.

F65: alternator is not old.

F66: connection is tight.

F67: connection is not tight.

F68: Replace the bulb.

F69: Replace the alternator with high amperage.

F70: Repair the alternator.

F71: Inspect the electrical connector and check if replacement needed.

F72: headlight still working.

**3.2 KNOWLEDGE BASE (RULES)**

IF engine starts,

AND runs normally,

THEN no repair needed.

IF engine starts,

AND not runs normally,

AND sluggish,

THEN clean the fuel line.

IF engine starts,

AND not runs normally,

AND not sluggish,

AND misfiring,

THEN adjust point gap.

IF engine starts,

AND not runs normally,

AND not sluggish,

AND not misfiring,

AND knocking,

THEN change engine oil.

IF engine starts,

AND not runs normally,

AND not sluggish,

AND not misfiring,

AND not knocking,

AND the output is low,

THEN take the car to mechanic.

IF engine not starting,

AND engine rotates,

AND gas is empty,

THEN fill in the gas tank.

IF engine not starting,

AND engine rotates,

AND has gas,

THEN take the car to the mechanic.

IF engine not starting,

AND engine not rotating,

THEN change the battery.

IF tyres not inflated,

AND tyres are punctured,

THEN Get punctured repaired.

IF tyres not inflated,

AND tyres are not punctured,

THEN get tyre Inflated.

IF tyres inflated,

AND tyres misaligned,

THEN get tyres aligned.

IF tyres inflated,

AND tyres aligned,

AND tyres not moving smoothly,

THEN apply oil in the axle.

IF tyres inflated,

AND tyres aligned,

AND tyres moving smoothly,

AND tyres not vibrating,

THEN no repair needed.

IF tyres inflated,

AND tyres aligned,

AND tyres moving smoothly,

AND tyres vibrating,

AND tyres have dirt/mud,

THEN clean the dirt/mud.

IF tyres inflated,

AND tyres aligned,

AND tyres moving smoothly,

AND tyres vibrating,

AND tyres don’t have dirt/mud,

AND noisy sound from bearing,

THEN change wheel bearings.

IF tyres inflated,

AND tyres aligned,

AND tyres moving smoothly,

AND tyres vibrating,

AND tyres don’t have dirt/mud,

AND no noisy sound from bearing,

THEN take the car to mechanic.

IF brake pedals hard,

AND car unused for long,

THEN check for rusting near pedal.

IF brake pedals hard,

AND car not unused for long,

THEN repair leaking vacuum.

IF brake pedals not hard,

AND pedal squishy,

AND there’s leakage on fluid master cylinder,

THEN fix the leakage.

IF brake pedals not hard,

AND pedal squishy,

AND there’s no leakage on fluid master cylinder,

THEN replace the cylinder.

IF brake pedals not hard,

AND pedal not squishy,

AND car pull one side while braking,

THEN take car to mechanic.

IF brake pedals not hard,

AND pedal not squishy,

AND car does not pull one side while braking,

AND rotors still thick,

THEN resurface rotors.

IF brake pedals not hard,

AND pedal not squishy,

AND car does not pull one side while braking,

AND rotors not thick,

THEN replace the pads.

IF headlight still working,

AND headlight dim,

THEN replace the bulb.

IF headlight still working,

AND headlight does not dim,

AND alternator is old,

THEN Replace the alternator with high amperage.

IF headlight still working,

AND headlight does not dim,

AND alternator is not old,

THEN Repair the alternator.

IF headlight not working,

AND connection is tight,

THEN Inspect the electrical connector and check if replacement needed.

IF headlight not working,

AND connection is not tight,

THEN replace bulb.

**3.3 DESIGN**

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We use CLIPS rule to develop our system because it’s easy to handle the codes. The picture above shows how the system works. Firstly, the system will request user input, whether to read the information about the system or simply proceed to use the system. Next, the system asks about the problem type for the vehicle. After that, the system will ask questions related to the parts of vehicle that have been chosen. Lastly, the result will be shown for user to take action of their vehicles.

**4.0 ATTACHMENT**

**4.1 TRANSCRIPT**

|  |  |
| --- | --- |
| Fudhail | Assalamualaikum En. Danial, pertama sekali, saya ingin perkenalkan diri kami iaitu saya Ahmad Fudhail dan rakan-rakan saya Abdul Muniif dan Muhammad Firas. Terima kasih En. Danial kerana sudi meluangkan masa lapang encik bersama kami untuk interview hari ini. |
| En. Danial | Waalaikumsalam, ya sama-sama. |
| Fudhail | Okay En. Danial, boleh encik perkenalkan diri sedikit tentang diri encik and pengalaman encik selama menjadi seorang mechanic? |
| En. Danial | Nama saya Danial, saya dah menjadi mechanic selama lebih kurang 10 tahun. Dulu saya bekerja sebagai mechanic di kilang BMW dan sekarang saya running business bengkel kereta saya sendiri. |
| Fudhail | Ok terima kasih En. Danial. Untuk soalan pertama interview kita, boleh ke encik terangkan macam mana cara enjin, tayar, brek dan lampu kereta berfungsi dan apa masalah biasa yang boleh berlaku dengan sistem-sistem ini? |
| En. Danial | Enjin ni satu sistem kompleks bahagian bergerak yang function untuk convert bahan api kepada tenaga untuk menggerakkan kereta. Masalah biasa yang boleh berlaku dengan enjin termasuk perkara seperti tekanan minyak rendah, penjimatan bahan api yang lemah dan pelepasan berlebihan.  Tayar pula satu komponen penting untuk mengekalkan sentuhan antara kenderaan dan jalan,so untuk membolehkan kereta kita bergerak atas jalan. Masalah tayar yang biasa selalunya bunga haus, tekanan tayar rendah dan pancit.  Sistem brek bertanggungjawab untuk memperlahankan dan memberhentikan kenderaan. Masalah brek biasa termasuk pad haus, kebocoran cecair brek dan masalah dengan kaliper brek.  Sistem lampu kenderaan bertanggungjawab untuk menyediakan pencahayaan di jalan raya di hadapan semasa memandu pada waktu malam atau dalam keadaan cahaya malap.Masalah biasa yang boleh berlaku dengan sistem lampu boleh jadi mentol lampu terbakar dan masalah wiringlah biasanya. |
| Fudhail | Boleh encik Danial explain teknik-teknik untuk mengesan dan prosedur untuk selesaikan masalah yang encik Danial gunakan untuk kenal pasti dan menyelesaikan masalah sistem-sistem ni? |
| En. Danial | Untuk check problem enjin, saya guna teknik combination of visual inspections, guna alat untuk diagnostik kereta menggunakan komputer dan test drive kereta customer. Untuk problem tayar, saya check kedalaman bunga tayar dan guna visual inspection untuk periksa any tanda haus atau kerosakan. Untuk masalah brek, cara pemeriksanaannya sama macam cara saya check enjin. Semua tu cuma basic atau starting method saya untuk periksa masalah kereta, lepas semua proses tu saya and team start periksa lebih mendalam. |
| Fudhail | Ohh baik-baik. Soalan next, boleh encik bagi contoh kes diagnostik yang sangat mencabar yang pernah encik hadap pada masa lalu, dan cara encik tangani masalah tu? |
| En. Danial | Satu kes yang sangat mencabar yang saya pernah jumpa ialah masalah dengan sistem powertrain kenderaan hibrid. Masalahnya susah untuk didiagnosis sebab ada interaction antara enjin petrol, motor elektrik dengan bateri. Saya terpaksa bergantung pada sistem diagnostik onboard kenderaan dan alat diagnostik special untuk mengenal pasti dan menyelesaikan masalah. |
| Fudhail | Boleh encik explain proses semasa mengenal pasti dan solve isu dengan enjin, tayar dan sistem brek and cabaran yang perlu dihadapi? |
| En. Danial | Pada masa ini, proses kenal pasti dan menyelesaikan masalah dengan enjin, tayar dan sistem brek selalunya melibatkan visual inspection, guna alat untuk diagnostik kereta menggunakan komputer dan test drive. Proses macam ini selalunya boleh memakan masa dan mungkin tak selalu dapat kenal pasti punca masalah. Selain itu, susah juga nak mendiagnosis masalah dengan teknologi canggih macam kenderaan elektrik dan hibrid, yang memerlukan alat dan teknik diagnostik khusus. |
| Fudhail | Apa pendapat encik dalam melihat expert system dalam automotive ni boleh meningkatkan proses diagnosis waktu sekarang? |
| En. Danial | Bagi saya expert system boleh improve proses sekarang dengan berikan cara yang lebih tepat dan cekap untuk mendiagnosis dan selesaikan masalah kenderaan. |
| Fudhail | Boleh encik memberikan mana-mana contoh expert system lain yang encik pernah gunakan dan pendapat encik lepas gunakannya? |
| En. Danial | Saya biasa guna beberapa expert system, seperti yang digunakan oleh pengeluar kereta dan kedai repair. Saya mendapati pertolongan expert system ni memang sangat dapat membantu pekerjaan saya untuk nak diagnosis masalah-masalah kereta di bengkel saya. |
| Fudhail | Saya rasa itu sahaja soalan-soalan yang nak saya tujukan pada encik. Terima kasih sebab sudi luangkan untuk bantu projek kami ini. |
| En. Danial | Baik sama-sama. Tiada masalah. |

**4.2 SOURCE OF KNOWLEDGE**

|  |  |
| --- | --- |
| **Date and Time** | 20th December 2022, 8:00pm. |
| **Expert** | Encik Danial from M Brothers Garage |
| **Platform** | Online meeting (Google Meet) |

**4.2.1 Examples of knowledge**

**Brake**

|  |  |  |
| --- | --- | --- |
| *Variables* | *Number of Values* | *Possible Values* |
| *Symptoms* | *6* | * *Brake Pedal Hard.* * *Unused for long.* * *Squishy feel.* * *Leakage of fluid.* * *One side while braking.* * *Rotors still thick.* |
| *Solution* | *7* | * *Repair leaky vacuum.* * *Fix the leakage.* * *Replace the cylinder.* * *Resurface rotors.* * *Replace the pads.* * *Take Car to Mechanic.* * *Check for rusting near pedals.* |

**Engine**

|  |  |  |
| --- | --- | --- |
| *Variables* | *Number of Values* | *Possible Values* |
| *Symptoms* | *6* | * *Run Normally* * *Rotate* * *Sluggish* * *Misfire* * *Knock* * *Gas Tank* |
| *Solution* | *7* | * *No need repairs.* * *Clean the fuel line.* * *Adjust point gap.* * *Change engine oil.* * *Take Car to Mechanic.* * *Fill gas*. * *Change the battery.* |

**Tyre**

|  |  |  |
| --- | --- | --- |
| *Variables* | *Number of Values* | *Possible Values* |
| *Symptoms* | *7* | * *Tyres inflated.* * *Tyres punctured.* * *Tyre aligned.* * *Moving freely.* * *Tyres vibrating.* * *Mud or dirt present.* * *Wheel bearings*. |
| *Solution* | *8* | * *Get tyres aligned.* * *Apply oil in the axle.* * *No repair needed.* * *Clean mud and dirt* * *Change wheel bearings.* * *Take care to mechanic.* * *Get tyres inflated.* * *Get puncture repaired.* |

**Headlight**

|  |  |  |
| --- | --- | --- |
| *Variables* | *Number of values* | *Possible Values* |
| *Symptoms* | *4* | * *Working headlight.* * *Headlight dim.* * *Connection tight.* * *Alternator old.* |
| *Solution* | *4* | * *Replace the bulb.* * *Inspect the electrical connector and replacement if needed.* * *Replace the alternator with high amperage.* * *Repair the alternator.* |

**5.0 CONCLUSION**

In conclusion, an automotive expert system for vehicle faults detection can greatly benefit car owners and improve the car maintenance process. the system can accurately diagnose a wide range of problems, including those associated with engine, tire, and brake systems. The development of this system can bring improvements to the safety, efficiency, and cost-effectiveness of car maintenance and repair, reducing the reliance on mechanics or repair shops. The expert system can aid in making the process of detecting vehicle faults easier, but it's still important to pay attention to warning signs and make informed decisions based on the specific circumstances of the vehicle. It's also important to remember that vehicle repair is a complex field, and that there is no one-size-fits-all approach to diagnosing and fixing problems. Nevertheless, it's important to remember that the expert system should be used as a guide and that professional help from mechanics or repair shops is still necessary in certain circumstances. Ultimately, the key is to find a solution that ensures the safety and proper operation of the vehicle.