UNIVERSITI TEKNIKAL MALAYSIA MELAKA

DEVELOPMENT OF IN-CABIN INTELLIGENT SAFETY SYSTEM AGAINST CARBON MONOXIDE

This report is submitted in accordance with the requirement of the Universiti Teknikal Malaysia Melaka (UTeM) for the Bachelor of Mechanical Engineering Technology (Automotive) with Honours.

by

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ABSTRACT

This research aims to design a new concept of the carbon monoxide detection system, which carries a similar goal as another developed system which is to give warning the occupants inside the car cabin about the presence of carbon monoxide toxic gas. The new intelligent system was simply designed to improve the previous concepts in order to compromise user compatibility and cost-effectiveness. The new system's criteria are compact, reliable and low-cost, making the system affordable to car owners. In order to produce a low-cost carbon monoxide detection system, the selection of components used in the system plays an important role in the present work. The Arduino UNO R3, HC-05 Bluetooth module and MQ-7 carbon monoxide semiconductor gas sensor have been chosen for the new system as the components are affordable in price. Besides that, the semiconductor sensor has been proven as effective in the previous carbon monoxide detection system project. To make sure the device is compatible to be installed in vehicle, the design is made up compact which combines the control unit, the Bluetooth module and a sensor in the main body is mounted inside the vehicle cabin, the warning signal and sound is at the main body while the second warning signal and sound will be displayed at the occupant’s screen mobile phone which has been connected to Bluetooth module. The

position of the sensor inside the body is very important as it carries the responsibility to detect the carbon monoxide that goes inside the cabin efficiently. At the end of this project, a prototype of the new system has been produced to be tested in the real situation. There are several tests set up with some condition to observe the ability of the device. Based on the result collected, the criteria of the new-built system have answered the objectives of the present work. The strength and weakness of the present system were also discussed to further improve the developed product.

ABSTRAK

Penyelidikan ini bertujuan untuk mereka bentuk konsep baru sistem pengesan karbon monoksida, yang membawa tujuan yang sama sebagai satu lagi sistem yang dihasilkan untuk memberi amaran kepada penghuni di dalam bahagian kabin kereta mengenai kehadiran gas beracun karbon monoksida. Sistem baru yang pintar direka mengambil kira kekurangan sistem sedia ada terutama untuk aspek kebolehsuaian dan kos yang rendah. Kriteria sistem baru ini adalah reka bentuk yang ringkas, kemampuan yang tinggi dan kos rendah supaya system ini dapat dipasang pada semua jenis pengangkutan ringan dan berat di Malaysia. Dalam usaha untuk menghasilkan satu sistem pengesanan karbon monoksida kos rendah, pemilihan komponen yang digunakan dalam sistem memainkan peranan yang penting dalam proses penghasilan system ini. Arduino UNO R3, HC-05 modul Bluetooth dan MQ-7 karbon monoksida sensor semikonduktor telah dipilih untuk sistem baru sebagai komponen kerana kesemua komponen tersebut boleh didapati dengan harga yang rendah dan berpatutan. Selain itu, sensor semikonduktor telah terbukti berkesan dalam projek sistem pengesanan karbon monoksida sebelum ini. Untuk memastikan peranti itu serasi untuk dipasang di dalam mana mana kenderaan, reka bentuk

dibuat secara padat yang menggabungkan unit kawalan, modul Bluetooth dan sensor dalam badan utama, isyarat amaran dan bunyi adalah di badan utama manakala isyarat amaran dan bunyi yang kedua akan dipaparkan pada skrin telefon mudah alih yang telah disambungkan kepada aplikasi Bluetooth. Kedudukan sensor di dalam badan utama diletakkan pada keadaan yang mudah untuk mengesan gas karbon monoksida kerana ianya sangat penting dan bertanggungjawab untuk mengesan gas karbon monoksida yang masuk ke dalam kabin kereta. Pada akhir projek ini, prototaip sistem baru dihasilkan untuk diuji dalam keadaan sebenar. Terdapat beberapa ujian yang dilakukan dalam beberapa keadaan untuk melihat keupayaan peranti. Berdasarkan keputusan yang dikumpul, kriteria sistem baru dibina telah memenuhi objektif penyelidikan. Kekuatan dan kelemahan sistem ini juga dibincangkan untuk peningkatan selanjutnya.

DEDICATION

To my beloved parents, Abdul Wahab Ahmad and Rawiyah Jusoh, my supportive family and all my cherished friends whose supports and prayers have been endless during a long period of my studies.

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LIST OF SYMBOLS

^{o} F	-	Farad
^{o} C	-	Degree Celcius
m	-	meter
Hz	-	Hertz
s	-	second
%	-	percentage
W	-	Watt
A	-	Ampere
V	-	Voltage

LIST OF ABBREVIATIONS

CO	Carbon Monoxide
O_2	Oxygen
NDIR	Non-Dispersive Infrared
QCL	Quantum Cascade Laser
InVCO	In vehicle CO detector with auto roll window
InCISSCO	In-Cabin Intelligent Safety System against CO
NO_X	Nitrogen Oxide
PPM	Parts per million
Hb	Haemoglobin
COHb	Carboxyhaemoglobin
NH_3	Ammonia
NO_2	Nitrogen Dioxide
LCD	Liquid Crystal Display
PC	Personal Computer
SnO_2	Tin Oxide
MOS	Metal Oxide Semiconductor
MEMS	Micro-Electro-Mechanical Systems
LED	Light-Emitting Diode

USB	Universal Serial Bus
AC	Alternate Current
DC	Direct Current