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Solar Powered Car Cabin Cooling System based on IOT

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ABSTRACT: Automobile owners especially are facing lots of issues as the temperature here is simply high, once parked underneath the hot sun. The temperature of the interior of a car gets increased substantially during day time when parked under un-shaded parking area for long duration. It is very uncomfortable for the passengers and driver during the start of the driving as the air conditioner will take time to fully cool the interior of the vehicle. This paper mainly focuses on ways to reduce the interior temperature of the parked vehicle. A system has been designed that employs the solar panel, battery, inlet and exhaust fans, temperature sensor and an electric control circuit. The inlet air fan is located lower than the exhaust air fan at the car model as the hot air moves up and to have a better air flow distribution. It was observed that the interior temperature of the car model decreased significantly when the system was installed. This technique incorporates a separate controller that manages the automated temperature control unit. The system starts once the temperature reaches forty degree and stops once the temperature comes below thirty degrees as per our setting in controller. This easy projected system provides comfort to users thanks to its capability in rising the standard of air and wet within the car's cabin. Experiments were conducted in open sun rays with completely different close temperature and therefore the fastened temperature at that the good system to be activated. It had been determined that the new air temperature within the automobile decrease significantly once the good ventilation was on. The ventilator inhales fresh air from outside into the inside cabin of a vehicle and exhales hot air to the outside. On a sunny day, solar energy can be used to run the ventilator, and to charge the battery simultaneously. During a cloudy day, the ventilator can be driven by the battery. In this paper, heat transfer and energy balance inside the car were investigated. Moreover power consumption of the motor, power produced from the solar panel, radiation effect and battery charging time were investigated. The present study suggests that the motor in the existing ventilator should be replaced by a high speed motor. It is found that more electricity is needed for high speed motor in an improved ventilator. In this paper, a commercially available ventilator has been modified to improve its performance. The modification has increased air flow rate from 20 cfm to 110.5 cfm. The improved ventilator provided at least 11% better result of reducing the temperature inside a car compared to the existing one.

KEYWORDS: Cooling System, Raspberry Pi, Solar Panel, Temperature Sensor.

I. INTRODUCTION

In modern era, most people drive cars and during driving sometimes the cars are needed to park in the open area where it is directly exposed to the sunlight. If the car is parked for too long time exposing the sunlight, the air inside the car becomes very hot. The temperature inside the car can easily rise to 60°C. Even in fairly cloudy day, the temperature inside the car can easily reach 55 °C. It is difficult to get on a car having exposed several hours to solar radiation. The hot temperature inside the car absolutely makes the driver feel uncomfortable in the first 10 minutes (Mezrhah and Bouzidi, 2005). In recent years, many works were reported on thermal comfort inside a car (Bureau et al., 2004; Martinho et al., 2004; Farrington et al., 1999; Jaksic et al., 2003). In a sunny day, the conditions of comfort inside a car depend closely on the exchanges of thermal radiation between the vehicle and its environment as well as internal radiation inside the car compartment. The radiation is undoubtedly the most instantaneous phenomena of energy transfer. To convince one, it is sufficient to consider the immediate feeling of relief which one experiences when one takes a shady road after having driven a long time in a sunny day.



II. RELATED WORK

İsmail durgun et al (2015) worked on a physical prototype of radiator which is used as a cooling system in automotive vehicle system. Ethylene glycol is considered as the working fluid different temperature readings were recorded to identify the heat loss and savings. The engine coolant temperature of approximately 90 °c inside the vehicle with radiators become discovered to be 120 °c in radiator. Overall 13euro saving was depicted in the present study. D irathod (2015) Worked on a radiator tank where salt (sodium chloride) was used as a running fluid and water as a cooling agent. Complete study was performed experimentally and was found salt has higher melting factor of about 1400-1500. Material used for the radiator tank was brass fabric. The results from the study stated that where sodium is used as running fluid soaks more heat from the engine and gives high cooling effect to the engine with the improvement in overall performance. (tripathi&chandra, 2015) studied the effect of nano materials in the working fluid of radiator which is used as a cooling system in engine of automotives Radiator consist of various other parts also i.e. radiator fan, collent etc. with the increase of pollution in environment author also suggested that use of nano particles in working fluids of engine can result in reduction of pollution to the environment. In the present study nano particles such zinc primarily based nanofluids (znfe2o4) using chemical coprecipitation approach and its software is used in an vehicle cooling device alongside with combination of ethylene glycol and water(50:50).

Temperature variations in a parked vehicle had been investigated by Dadour et al. [2]. A simple 'greenhouse' model was developed using available local meteorological data for predicting the vehicle interior temperatures. The meteorological data and temperature data collected on parked vehicles during particular summer seasons were employed to measure the statistical model. The environmental temperature and radiation data were used as input for the model. The results showed that the temperature inside the cabin of a black vehicle is 5 °C higher than that of a white vehicle on a hot summer day. The cabin's temperature has reduced about 3 °C by lowering the driver's window of the vehicle by 2.5 cm.

III. METHODOLOGY

During the summer season, for cars parked outside the cabin temperature can become be too high or too low thus making it difficult for drivers to sit comfortably in the cars to operate them. This Project presents a solution to this problem. Designing project to keep the interior of a car at a comfortable temperature while the car is parked in parking lot or on the driveway. This Project presents a solution to this problem. Designing project to keep the interior of a car at a comfortable temperature while the car is parked in parking lot or on the driveway.

Select the suitable PV cells for harvesting solar energy and storage using battery to actuate various air cooling components such as cooler and arduino UNO board. Arduino UNO board continuously senses the data from the sensors connected to it which measures the moisture and and temperature, forwards it to Raspberry Pi over USB interface Raspberry Pi is installed with RasbianJessy which is a LINUX based Operating System (OS).All the coordination functions are performed in Raspberry Pi implemented using python programming.

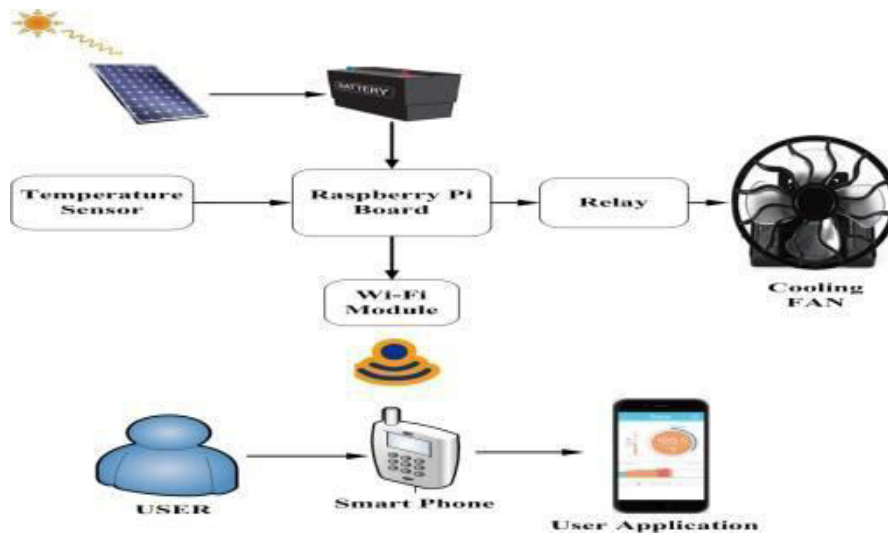


Fig1: Proposed Methodology

Temperature Sensor

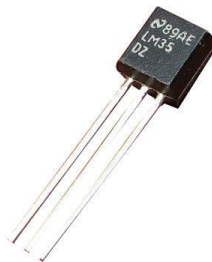


Fig 2: Temperature sensor

A temperature sensor is a device used to measure temperature. This can be air temperature, liquid temperature or the temperature of solid matter. There are different types of temperature sensors available and they each use different technologies and principles to take the temperature measurement.

Thermistors can be very small in size. They consist of a sensing element which can be either glass or epoxy coated and have 2 wires so they can be connected to an electric circuit. They measure temperature by measuring the change in resistance of the electric current. Thermistors are available as either NTC or PTC and are often low cost.

RTDs or Resistance Temperature Detectors work in a similar way to Thermistors and measure ohmic resistance to measure temperature. They are connected to a circuit in a similar way to a thermistor but they have a much wider temperature range and can measure extreme temperatures.

Thermocouples use two conductors, made up of different metals that are joined at the end to form a junction. When this junction is subjected to heat, a voltage is produced that is directly proportional to the temperature input. They are highly versatile as different metal combinations allow for different measurement ranges; however, they lack the fine accuracy of NTC's and RTD's making them the least precise out of the three types

Temperature Probes are a very common and diverse type of temperature sensor. They consist of either a thermistor, a thermocouple or RTD sensing element and can be finished with a terminal head. All three types of sensor can be manufactured into a variety of housing types – stock and bespoke. This allows for enhanced utility, that may span over a multitude of different environments and media that they encounter.

Raspberry Pi is the name of a series of single-board computers made by the Raspberry Pi Foundation, a UK charity that aims to educate people in computing and create easier access to computing education. Raspberry Pi is a credit card sized single computer board. It can be used for many of the things that your desktop PC does, like spreadsheets, word-processing, games and it can also play high definition video. It was developed by Raspberry Pi foundation from

UK. The raspberry pi is ready for public consumption since 2012 with the idea of producing a cheap educational microcomputer for students and children. The raspberry pi is created to be something to encourage learning, innovation and experimentation. The raspberry pi computer is portable and less expensive. Most of the raspberry boards are used to built raspberry pi projects, mobile phones, and also used in solar street lights. The start of 21st century saw a huge growth in mobile computing technologies, a large segment of this being driven by the mobile phone industry. The 98 percent mobile phones were using ARM technology. The ARM technology would later end up being featured on the raspberry pi with ARM processor core being used.

The system comes into two different models that is model A and model B. The main differences between these two are USB ports. The model A board which does not includes a Ethernet port and will consume less power. The model B that includes an Ethernet port and manufactured in China. The raspberry pi comes with set of open source technologies that is communication and multimedia of web technologies and ability to interact with microcontroller. It is portability of a mobile device.

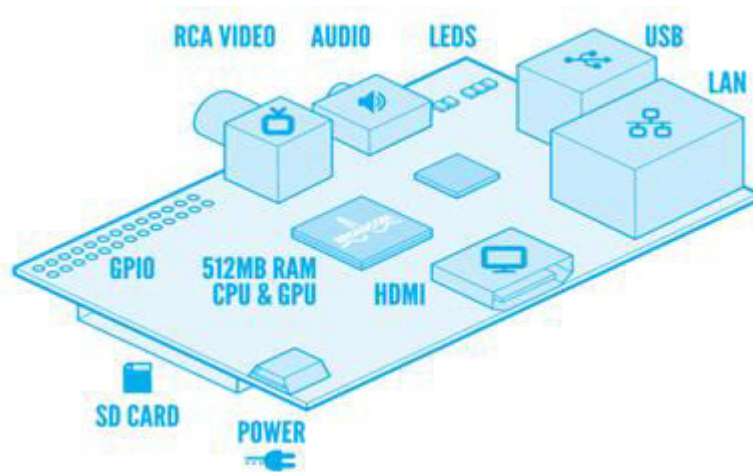


Fig 3: Raspberry Pi

Raspberry Pi Specifications:

Memory:

The raspberry pi comes equipped with 256 Mb of SDRAM in older version model A and 512 Mb on the newer versions model B. It is a small size PC compare with other PCs. The normal PCs RAM memory is available in gigabytes but in this type of application the RAM memory is more than 256 Mb or 512 Mb.

CPU:

The CPU is the main component of the raspberry pi. It is responsible for carrying out the instructions of a computer via mathematical and logical operations. The raspberry pi is a good company using the ARM11 series processor. It has joined the ranks of phone, Samsung galaxy.

GPU:

The graphics processing unit (GPU) is a specialized chip in raspberry pi. It is designed to speed up the manipulation of image calculations. The raspberry pi comes equipped with a Broadcom video core IV and it is supported for OpenGL.

Ethernet Port:

The raspberry pi Ethernet port is main gateway for communicating with other devices. You will able to use raspberry pi Ethernet port to plug your home router to access the internet.



GPIO Pins:

The general purpose input and output pins on the raspberry pi are used to connect with the other electronic boards. The GPIO pins can accept input and output commands based on programmed raspberry pi.

The raspberry pi provides digital GPIO pins. These pins are used to connect other electronic components. For example you can connect it to the temperature sensor which transmits digital data.

XBee Socket:

The raspberry pi provides two XBee socket for wireless communication purpose.

Power Source Connector:

The power source selector is a small switch it is located on side of the shield that can be used to enable an external power source.

UART:

The UART are a serial input and output port. This can be used to transfer the serial data such as text and it is useful for transforming the debugging code.

Car AC app can be used to check the inside car temperature. The car cabin temperature can be controlled easily. Since the solar energy is used, the usage is optimized. As the user enters the car he don't feel uncomfortable.

IV. EXPERIMENTAL RESULTS

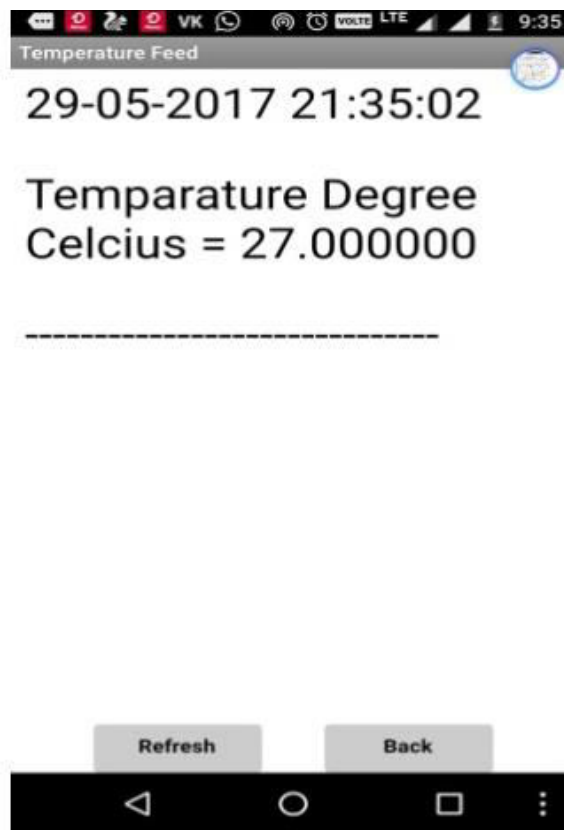


Fig4: No Obstacle

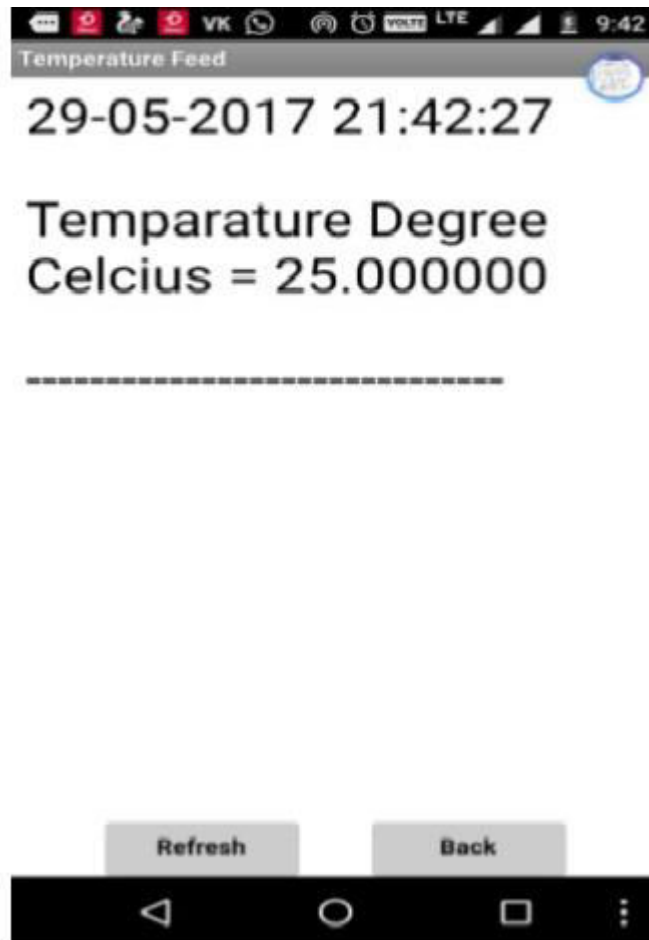


Fig5:Obstacle in the range less than 10cm

V. CONCLUSION

This system was developed and investigated with the aim to reduce the temperature of the car interior. The experiment was performed on a prototype model of the car using CPU casing. The system employs solar panel, battery, exhaust with blower fans, and electronic control circuit. It was observed that the temperature inside the car model decreased significantly to about 36.3 °C at 4.00 pm which is close to ambient temperature when the system is installed into the model. Also, it is noticed that the temperature is reduced about 2 °C every hour after both fans were powered on. The system allows to keep car cabin cool as per the requirement of user and allows to control the system through mobile phone. The ultra sonic sensor detects the obstacle that comes in the way while taking the car reverse. The car is safe from damages. The rear camera fixed enables to view the background while taking reverse so that the driver can drive easily.

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