TRANSMISSION AND LOGGING OF DATA FOR ANALYSIS USING IOT

ABSTRACT

This paper consists of the methodology to get the real-time data from a particular system of machine to any place. Particularly we are executing in the formula student racing car. The data from the machine can be visualized using sources like ThingSpeak for the analysis purpose. The data would mainly consist of accelerometer data, coolant temperature data, gear count, and speed which are some part of data required for the analysis. We are mainly using the raspberry pi for controlling all the sensors. This also provides the students a cheap and portable way to get data for analysis of their cars.

KEYWORDS: - Raspberry pi 3, ADXL345, PT100, Hall effect sensor, Real-time data transmission, data logging.

INTRODUCTION

The **Internet of things** (**IoT**) is the network of physical devices, vehicles, home appliances and other items embedded with electronics, software, sensors, actuators, and network connectivity which enables these objects to connect and exchange data.

Vehicles in today's world have become the most important feature in human society, so the more we increase its efficiency as well as the safety of the people present inside them.

For increasing the performance, we know that Analysis is the heart of engineering whether it is of a small thing like toys or big things like airplanes, it is one of the most important part. In case of automobile, our main aim is to increase the performance of the car, for which the analysis department is responsible. The main thing the analysists do is study the forces/torques acting on the frame, surrounding conditions (nature of road), the temperature of the vehicle, the current situation of the vehicle (i.e. speed or the gear in which the vehicle is operating), etc. So the data first taken before manufacturing is the data taken from the documents and the papers and is approximate taking into considerations all the parameters on the basis of which they manufacture the car but due to approximations there are errors which lead to decrement in the performance, and also there are some errors or problems which only surface during the run-time of vehicle and during the run-time each parameter may be different and to take into consideration all those parameters and then try to think that what could have gone wrong, so if we provide the analysists the real-time data (pitch yaw and roll or forces in particular member or the temperature at that instant) during the run of the car then it would be lot easier for them to do the analysis and try to sort out the problem. This was the main problem faced by our college team of Formula Student Racing in which we build the formula racing car full from scratch that is full manufacturing from welding to painting. As our car was prepared by us so there is no onboard diagnostic system to do the thing which is done in all other vehicles.

So by logging as well as providing the real time data (accelerometer reading in all the 3 axes, coolant temperature, the speed of the car , the paddle shifter reading or the current gear) .So in our solution we would be using ADXL345 accelerometer which would give data in all the three axes, for measuring the coolant temperature we would be using PT100 temperature sensor, hall effect sensor for measuring the speed of the car and will also be showing the current gear of the car for pedal shifter.

For integrating all the sensors and managing all the data we will be using the Raspberry pi 3 microprocessor and would do the program by python. We will be storing as well as uploading the data to the cloud.

TECHNICAL SOLUTION

The way of integration and the details of all the sensors used for logging and transmission of the data is give as follows

SENSORS

Following are the sensors which we would be using and the reason why we are using it

ACCELEROMETER: ADXL345

Accelerometer calculates both static (e.g. gravity) and dynamic (e.g. start and stop) acceleration. They track angles for long period of time. The accelerometer we are going to use is ADXL345. It measures data from 3-axis and has a high resolution (13 bit) of up to +-16g. It is small, thin and consumes low power. We are using this sensor because this sensor gives the data quiet precisely and it is ranging from 2g to 16g.

TEMERATURE SENSOR: PT100

The temperature sensor which will be calculating the temperature of coolant will be PT100. The platinum resistance thermometers offer a wide range i.e. -200 to +850-degree centigrade. As we know that the temperature in the coolant may rise quite a lot so we had to choose the sensor accordingly.

I2C SHIELD ADAPTER

This shield is the most useful component as it connects raspberry pi 3 and accelerometer and the temperature sensor. These provides the same feature like motherboards. It provides a level shifted +5 12C Port.

HALL EFFECT SENSOR

The hall effect sensor is a device that varies output voltage due to the influence of magnetic field. We are using hall effect sensor for speed detection. This would mainly consist of 3 parts the sensor which would detect the change in magnetic flux which would be connected to the transmitter and a receiver. Or we may be using a small microcontroller with blue-tooth module for sending data to the raspberry pi.

RASPBERRY PI

Raspberry pi is a series of small single board computers. Contradicting to its size it can perform various functions and hence it is called mini-computer. The model which we are going to use in this project is raspberry pi 3.

These are some characteristics of raspberry pi 3:

CPU: Quad-core 64-bit ARM Cortex A53 clocked at 1.2 GHz
GPU: 400MHz Video Core IV multimedia
Memory: 1GB LPDDR2-900 SDRAM (i.e. 900MHz)
Network: 10/100Mbps Ethernet and 802.11n Wireless LAN
Peripherals: 40 GPIO,
Power source: 5 V via MicroUSB or GPIO header

PEDAL SHIFTER

Pedal shifter is a voluntary device. An electronic signal is sent to the clutch which makes the gear shift. In this way driver can control the gear of the vehicle. So, the pedal shifter which is working on pneumatics, the actuators will be controlled by the code from which we will take the signal for the current gear.

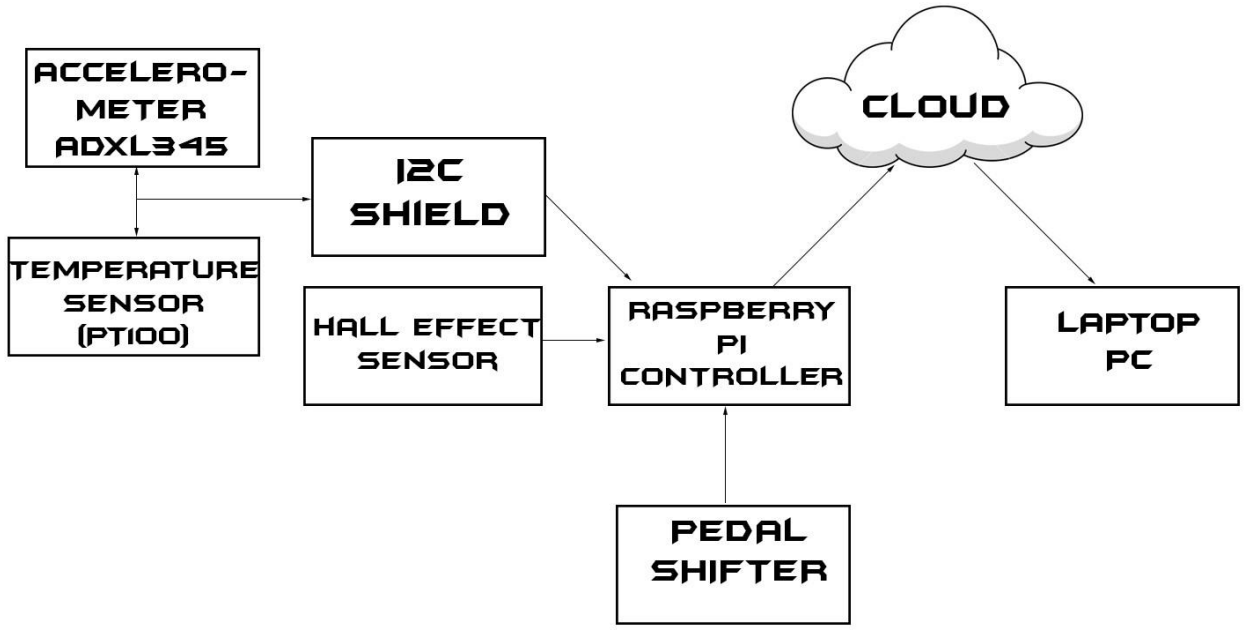
BASIC STRUCTURE

Firstly, for powering the pi we were thinking of connecting the pi to the batter which was already present in the car but then we would have to step down the voltage to 5 V as the batter present would be of 12 V, so we are directly using a 5 V rechargeable battery.

Now to set Raspberry Pi 3 up and running with a Linux OS. We would be using Raspbian, which is the official OS of the Raspberry Pi Foundation. Flash the image onto an SD card and start up the Pi and configured the hostname and password. We will enable SSH so that we can access the Pi remotely.

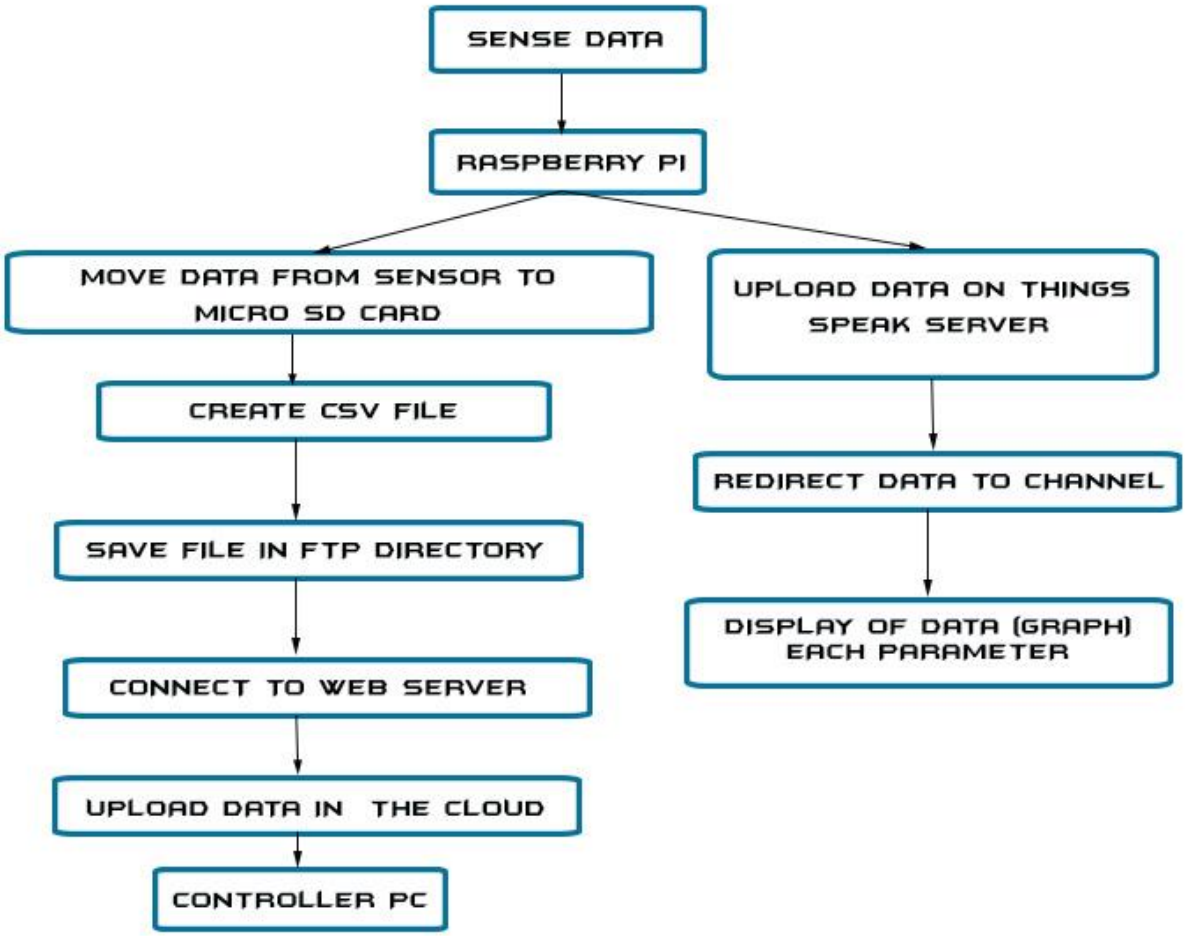
Then comes the part of Data logging and Real-time transmission of data which will be firstly from the accelerometer ADXL3450 i.e. the data will be given in ‘x’g (x is a value integer) in all 3 axes each will be taken in different column of log file. Secondly temperature readings of coolant from PT100(so that if the temperature increases beyond 80 degree C then we can turn on the radiator) there would be a led on the steering wheel which would give the indication by which the driver can understand when to turn on the radiator, also the temperature readings will be logged with time.

Thirdly speed of the car would be measured by the hall effect sensor which would basically have 3 parts first would be the hall effect sensor which would be detecting the change in flux number of times due to rotation of magnet attached to the wheel then this data would be transmitted with help of transmitter which would be connected to the hall effect sensor. Then this data would be taken by the receiver which would be connected to the raspberry pi. This would give us the speed of the car and which would be given on the steering of the driver as well as will be logged. The main purpose of logging the data is that if there is any problem with the internet network due to any reasons the data should not be lost so that at least analysis can be done further.



So basically, as the vehicle starts all our sensors would start taking the reading (i.e. ADXL345, PT100, hall effect sensor). The accelerometer ADXL345 and the temperature sensors PT100 would be connected with the I2C shield adapter (accelerometer and temperature sensor would be inter-connected). The I2C shield adapter would be connected to all the GPIO pins of the Raspberry pi 3. The Hall effect sensor would have connected with the extended GPIO pins over the I2C shield. The data of the current position of the gear will be detected from the program which would be actually controlling the gear shifter through the pneumatics and that would depend on the shifting of the driver, as the driver shifts the gear while changing the gear the changed gear will also be logged. Then the total data will be accessed by the raspberry pi controller.

There are libraries and repositories available on GITHUB for the ADXL345 sensor, PT100 sensor and the hall effect sensor for taking the input data.



Now for logging this data we are thinking of two ways first is that we take all the data and create a csv file (excel file) which would have each parameter in one column and which would be specified for the particular time. And then saving this csv file locally as well as in the cloud so that if something happens to the controller due to crash or any other reason the data is not lost. Then the data can be accessed from the cloud (which could be the google drive or any other).

Python has a built-in CSV module. After the connections with the sensors are established, the logger creates a new CSV(excel) with the current time as the name (so that it becomes easy to go back through logs in the future). The logger will accept an array of all of the data to be logged,

and it will then append a new row to the CSV that contains all of that data. We will be limiting the logging speed so that it only appends the data after interval of each one second

The other way is that we would transmit the data in each parameter directly to the platform on internet known as THINGSPEAK.

ThingSpeak is an open source Internet of Things (IoT) application and API to store and retrieve data from things using the HTTP protocol over the Internet or via a Local Area Network. ThingSpeak enables the creation of sensor logging applications, location tracking applications, and a social network of things with status updates.

We will have to write the python program to redirect the data from the sensors through the api keys which are provided by ThingSpeak after creating a channel. First, we login to ThingSpeak then we have to create and configure the channel and with the API keys provided we have to give the pathway to redirect the data from the raspberry pi controller to the server and now we need to connect the raspberry pi and the ThingSpeak server by the python program. When the sensor is uploading the data to the ThingSpeak server, the site will handle the data and then it would give us the graph or the way in which we need the data to be displayed with respect to the time till the current time.

So, this would mainly solve the problem of real time data and parameters will be sent directly and this would give a graph of all the past data till the current time.

CONCLUSION

So, summing up our project will help in gathering the accelerometer, coolant temperature, gear shifter data of the car in real time which will be a benchmark in the process of analysis. This will help the analysts to reduce the error from the data which was previously assumed. In addition, the sensors or the equipments used are easily available and in low cost i.e. like raspberry pi, ADXL345, etc. It will majorly effect the performance of the vehicle. Also, the data on which analysis is to be done can be accessed from anywhere. This will help SAE students in analysis of the car made by them. This has further scope of increasing the number of sensors used based on the data required during analysis.

Presently, anybody can hack the transmission data. In future security can be enhanced so that the data remains confidential.