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New System of Controlling Electric Car Using Concept of Accelerometer

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Abstract: *This paper implements and develops a new method of controlling the electric car by employing accelerometer. Generally in the history of evolution of electric cars, there is a lot of changes take place in almost all aspects of the electric car and tremendous advances have been made in the field of electric vehicles. But the basic operation of steering and acceleration system remains the same. So in addition to these advancements, we introduced a new method of controlling electric vehicles, i.e. basic and traditional type of acceleration and steering control is changed. The accelerometer is in-built in the controller which is given to the driver for controlling the vehicle acceleration and steering. The accelerometer in the controller senses the calibrated input from the driver. The controller itself analyses the input and drives the motor and also controls the speed accordingly to it. It gives a feeling of driving a one manned plane. Since there is no need of using legs to drive these vehicle even a paraplegic persons can drive this kind of electric car easily. This new method of controller used in electric vehicles mainly concerned on ease of driving.*

Keywords: Electric car, Car Controller, Accelerometer, Latest design, Freescale Freedom Board FRDM-Kl25Z

INTRODUCTION

The first electric cars were produced in the 1880s. In early 20th century electric cars were prevalent, when electricity was preferred in automobile propulsion. Advancement in internal combustion technology, and growing petroleum infrastructure, usage of gasoline car increased, which led to the decline of electric propulsion vehicles. But the energy crisis of 1970s and 1980s brought a renewed interest in electric vehicles. Though there is a renewed interest in electric cars, nothing greatly changed in method of controlling the cars acceleration and steering. In this paper, we design and implement a new controller system which can eliminate the present model of accelerator and steering in electric car. Before entering into this model we have to know about the electric car.

The electric vehicle (EV) is propelled by an electric motor, powered by rechargeable battery packs, rather than a gasoline engine. All of their power is derived from the main electricity, supplied to an on board battery which drives an electric motor within the vehicles. The Electric Motor gets its power from a controller and the Controller is powered from an array of rechargeable batteries. The electric vehicle operates on an electric/current principle. It uses a battery pack (batteries) to provide power for the electric motor. The motor then uses the power (voltage) received from the batteries to rotate a transmission and the transmission turns the wheels.

Electric vehicles can able to increase the amount of available power by using a direct motor-to-wheel configuration. Wheels can be used for both propulsion and as braking systems, by connecting multiple motors directly to the wheels and thereby increasing traction. Electric cars are significantly quieter than conventional internal combustion engine propelled automobiles and are typically easy to drive, and perform well. They also do not emit pollutant gases such as greenhouse gas, and giving a large reduction to local air pollution and greenhouse gas.

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SYSTEM OVERVIEW

In the proposed system, we suggest to utilize the Freescale freedom board FRDM-KL25Z for accessing the overall four wheeled vehicle control such as Accelerator and Steering. So the new car can be steered with a FRDM-KL25Z kit. Freescale freedom board FRDM-KL25Z is the major electronic unit used in this new method of accelerator and steering control. By using accelerometer MMA8451Q present in an electronic unit we can controls the direction and speed of the battery car. This accelerometer MMA8451Q is capable of detecting changes in orientation, angle of tilt with respect to gravity. With the help of these orientation and tilting angle measurements, we can programme an electronic controller unit, which controls the speed and direction of the car. This method of controlling the electric car will be one of the coolest features of the technology world.

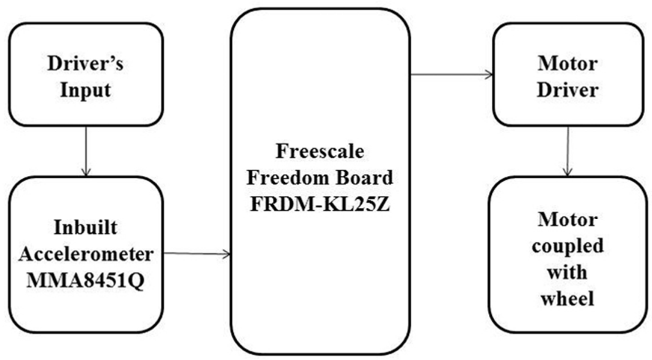

Fig.1 Block Diagram of the System

SYSTEM ARCHITECTURE

The construction of this system consists of two parts namely hardware development and software development. Hardware development involved the designing the circuit of the project while the software developments is focused on designing coding to be embedded in the hardware.

Hardware Developement

The new system of controlling electric car includes some of Hardware components. The main hardware components used in the car controller system are Freescale freedom board FRDM-KL25Z which has in-built acceleration sensor MMA8451Q.

Accelerometer MMA8451Q:

The in-built acceleration sensor or accelerometer MMA8451Q is capable of detecting changes in orientation, angle of tilt with respect to gravity. The MMA8451Q is a smart, low-power, three-axis, capacitive, micro machined accelerometer with 14 bits of resolution. This accelerometer is packed with embedded functions with flexible user programmable options, configurable to two interrupt pins. Embedded interrupt functions allow for overall power savings relieving the host processor from continuously polling data. There is access to both low-pass filtered data as well as high-pass filtered data, which minimizes the data analysis required for jolt detection and faster transitions. The device can be configured to generate inertial wakeup interrupt signals from any combination of the configurable embedded functions allowing the MMA8451Q to monitor events and remain in a low-power mode during periods of inactivity. The MMA8451Q is available in a 3 mm x 3 mm x 1 mm QFN package. But we have an in-built accelerometer in the Freescale freedom board itself.

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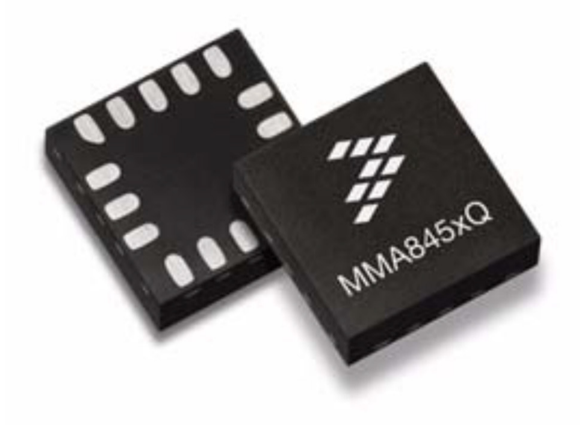

Fig.2 Accelerometer MMA8451Q

Freescale freedom board FRDM-KL25Z:

The main hardware component used is Freescale Freedom board FRDM-KL25Z. Simply saying Freescale Freedom board FRDM-KL25Z itself is the electronic controller unit. The Freescale Freedom KL25Z hardware, FRDM-KL25Z, is a capable and cost-effective design featuring a Kinetis L series microcontroller, the industry's first microcontroller built on the ARM® Cortex™-M0+ core. A Freescale MMA8451Q low-power, three-axis accelerometer is interfaced through an I2C bus and two GPIO signals. It features a KL25Z128VLK, a device boasting a max operating frequency of 48MHz, 128KB of flash, a full-speed USB controller, and loads of analog and digital peripherals.

Fig.3 Freescale Freedom Board FRDM-KL25Z

The FRDM-KL25Z hardware is form-factor compatible with the Arduino™ R3 pin layout, providing a broad range of expansion board options. The on-board interfaces include an RGB LED, a 3-axis digital accelerometer, and a capacitive touch slider. The I/O headers on the FRDM-KL25Z are arranged to allow compatibility with peripheral boards (known as shields) that connect to Arduino™ and Arduino-compatible microcontroller boards.

Software Development

Software development is to develop embedded software required to control hardware development. It is the process of coding computer program which is needed to operate hardware development. The Freescale Freedom board FRDM-KL25Z uses embed c codes. These codes are compiled using online embed c compiler. The code is as follows,

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```
#include "mbed.h"
#include "MMA8451Q.h"
PinName const SDA = PTE25;
PinName const SCL = PTE24;
PwmOut m1(PTA4);
PwmOut m2(PTA12);
PwmOut m3(PTC8);
PwmOut m4(PTC9);
#define MMA8451_I2C_ADDRESS (0x1d<<1)
void fwd(float i)
{
    m1=i;
    m2=0;
    m3=i;
    m4=0;
}
void rev(float i)
{
    m1=0;
    m2=i;
    m3=0;
    m4=i;
}
void lft(float i)
{
    m1=i;
    m2=0;
    m3=0;
    m4=i;
}
void rgt(float i)
{
```

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```
        m1=0;
        m2=i;
        m3=i;
        m4=0;
}
void stp()
{
        m1=0;
        m2=0;
        m3=0;
        m4=0;
}

int main(void)
{
   MMA8451Q acc(SDA, SCL, MMA8451_I2C_ADDRESS);
   printf("MMA8451 ID: %d\n", acc.getWhoAmI());
   while (true) {
      float x, y, z;
      x = acc.getAccX();
      y = acc.getAccY();
      z = acc.getAccZ();
        wait(0.1f);
      printf("X: %1.2f, Y: %1.2f, Z: %1.2f\n\r", x, y, z);

      if(y>0.3f)
      { rgt(y);}
      else if (y<-0.3f)
      { lft(abs(y));}
      else if (x<-0.3f)
      { fwd(abs(x));}
      else if (x>0.3f)
```

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```
        { rev(x);}
        else
        {stp();}

    }
}
```

WORKING

This system of controlling electric cars was mainly based on the principle of measuring the tilting angle and direction. The Freescale Freedom board FRDM-KL25Z senses the tilting angle and its direction by using inbuilt accelerator MMA8451Q. Thus by sensing this tilting angle and direction, it moves the electric car in forward, backward, left and right side almost in all direction with desired speed, based on the input given.

TABLE I
CAR CONTROLLER METHOD BY CONTROLLER TILT DIRECTION

Direction of tilt of controller	Movement of car
Forward Left Right Backward	Front Left Right Reverse

If you tilt the Electronic Controller Unit in forward direction slowly, the car tends to move in forward direction slowly. If you tilt the Electronic Controller Unit in same forward direction suddenly, the car also moves faster. Similarly we can move the electric car in almost all the direction with varying speed with ease. Thus the direction of tilting decides the direction of the car to move and the measure of angle of tilting decides the speed of the car. Since there is no clutch system in the electric car, there is no hindrance for controlling and varying the speed suddenly to our wish.

TABLE II
MOVEMENT OF THE CAR WITH TILTING ANGLE

ANGLE OF TILT	25°	30°	60°	70°	45°
MOTION	Easy Forward	Easy Backward	Maximum Forward	Maximum Backward	Left and Right

RESULTS

In this proposed system, the Freescale freedom board FRDM-KL25Z senses the tilting angle and its direction by using inbuilt accelerator MMA8451Q. Thus by sensing this tilting angle and direction, it moves the electric car in forward, backward, left and right side almost in all direction with desired speed, based on the input given.

If you tilt the controller forward, the electric vehicle moves forward. The angle and speed of tilting determines the speed of the vehicle. Similarly we can drive electric car in all direction and can control the speed of the car using electronic controller unit with ease.

CONCLUSION AND DISCUSSION

Thus we finally designed a four wheeled vehicle with a new controller unit which eliminates the old design of acceleration and steering method of controlling. This system gives the new experience of riding a vehicle such as virtual driving. By implementing this new system of controlling using electronic controller unit can increase the usage of electric cars. We can expand this project to heavy vehicles in near future. Since there is no need of using legs to drive these kinds of vehicle, even a paraplegic person can drive this kind of electric car easily. This new method of controller used in electric vehicles mainly concerned on ease of driving.

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