Staircase Climber

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i

***Abstract*— The paper describes the project that is intended to be a prototype of a machine that will help people, who find it a problem, to climb up and down on staircases. Our project is a 30x30cm machine which adjusts a box attached to a servomotor, with high torque, while climbing up and down a staircase. The machine is completely autonomous with path tracking and obstacle detection facility that keeps the box parallel to the ground irrespective of ascend or descend of the vehicle on the staircase. The whole machine is controlled by ATMEGA 8535 which is programmed using Codevision AVR software.**

Keywords*— *ATMEGA 8535, Accelerometer, Generalized equation

I. INTRODUCTION

OFTEN we hear senile or aged people complaining about the difficulties they have to face while climbing staircases of several storey buildings in the absence of elevators also while climbing railway bridge staircases. In fact, 30 percent of people over age 65 and 50 percent over age 80 suffer from injuries due to fall from the stairs. Of those who fall, 25% suffer injuries that reduce mobility and independence. In order to overcome these difficulties, we intend to make a prototype of a machine that will change the lives of people who find it a problem climbing up and down on staircases. Staircase climber is a vehicle which can especially be used by old people and physically challenged people to ascend and descend on staircases with ease. It's a vehicle as small as twice a skate board, and as steady as a car. Our project is to make a prototype of such an application. It will be a 30x30cm machine that will not only climb and descend a staircase with precision but also adjust a box that will always be parallel to the ground. It will be autonomous, that'll make use of line follower circuit made up of TCRT 5000 The vehicle will follow a line till it reaches the base of the staircase after which it'll climb the stairs. There will be a proximity obstacle sensor, SL-18500, that will detect a obstacle when ascending or descending the stair and stop the machine then and there. The vehicle is made with extremely stable geared DC motors each

II. PROPOSED SYSTEM

Fig 1 describes the working of the vehicle. An ATMEGA 8535 is used at the heart of the vehicle. The vehicle gets a 12 volt DC supply that is used to drive the 3.5 RPM motors.

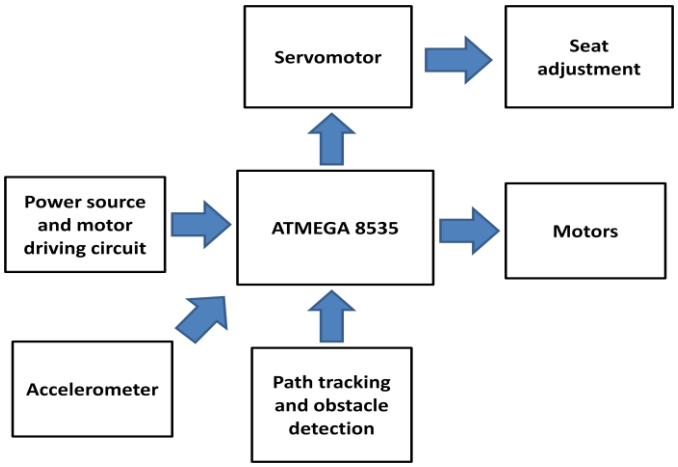

Fig. 1. Block diagram of the machine

The input voltage is given to a motor driver circuit. The motor driver circuit consists of 4 input data pins that are the outputs of the microcontroller. Each input is connected to a transistor and then a relay. According to the input data lines to the relay circuit each side of motors will be activated. The 8535 has 3 pins used as input that are connected to 3 sensors, TCRT 5000, which are used for line sensing. Also one pin on the port of 8535 is used for obstacle detection. Thus according to the input data on the pins of ports of microcontroller the motors at the base of the vehicle are moved.

Now as the machine starts ascending a staircase the accelerometer starts giving a linearly increasing voltage. This output of the accelerometer is given to the AVR which according to the code gives a particular OCR value to the servomotor which then changes the angle of the box. Similar working happens during the descending of the staircase.

The code fed in the AVR for adjusting the seat/box is a generalized code. A generalized code is the one that can be used for any staircase to adjust the box. The code is made with respect to an equation that is determined according to the linear increase and decrease of OCR value with that of the linear rise or decrease of ADC value. We can plot a graph for the equation, considering the ADC value as Y axis and OCR value as X axis. According to the values of OCR and ADC, a code is written which will help our vehicle climb a staircase of different slopes with the box still maintained parallel to the ground.

III. ACCELEROMETER

We have used MMA 7361 accelerometer which is a analog accelerometer. The MMA7361L is a low power, low profile capacitive micro machined accelerometer featuring signal

conditioning, a 1-pole low pass filter, temperature compensation, self test, 0g-Detect which detects linear freefall, and g-Select which allows for the selection between 2 sensitivities. It can sense movements on 3 axes, that is X, Y and Z. in the vehicle, because we have to sense the incline and accordingly adjust the seat we make use of X axis. The region of voltage varying from 0 to 90degree is from 1.5 volts to 2.5 volts. This voltage is applied to the ADC pin of 8535. The ADC in the 8535 converts this voltage to digital value that is between 230 to 450, thus providing high resolution.

IV. CODEVISION AVR

CodeVisionAVR software is a C cross compiler, Integrated Development Environment and Automatic Program generator designed for the Atmel family of microcontrollers. The program is a native 32-bit application that runs under the Windows 95, 98, 2000 and XP operating systems. The C cross-compiler implements almost all the elements of the ANSI C language, as allowed by the AVR architecture with some features added to take advantage of the specificity of the AVR architecture and the embedded system needs. The compiled COFF object files can be C source level debugged using the Atmel AVR Studio debugger.

The Integrated Development Environment (IDE) has built in AVR chip In-System Programmer that enables the automatic transfer of the program to the microcontroller after successful compilation/assembly. The ISP software is designed to work in conjunction with the Atmel STK500/AVRISP/AVRProg (AVR910 application note), Kanda Systems STK200+/300 development boards

We have written the code in CodeVision in such a way that the vehicle will be able to climb any type of staircase, proportional to its size, and adjust the seat as it ascends or descends. Hence it's a generalized code. Also the code works in synchronization with the path tracking and obstacle detection sensors.

V. RESULTS

In order to make a generalized code for the vehicle to climb a staircase a graph is to be plotted. X axis will be the OCR values and Y axis will be the ADC values. Depending on the ADC values, corresponding OCR1A value is selected. OCR values control the width of the ON time pulse width of the PWM pulse generated. For the clockwise or anticlockwise rotation of Servomotor, an ON pulse width of 1-2 ms is required.

The table and graph is as shown below:

TABLE I

ADC Values	OCR Values
256.7999552	14.2953
270.0356391	13.23568383
282.3577659	12.32212685
293.8843458	11.52657988
304.7119032	10.82755746
314.920396	10.20849271
324.5768017	9.656405719
333.7377841	9.160982378
342.4517074	8.713923321
350.7601822	8.308474792
358.699267	7.939084795
366.3004141	7.601147135
373.5912223	7.290808221
380.5960417	7.004819369
387.3364643	6.740422578
393.8317255	6.495261249
400.0990352	6.267309718
406.1538524	6.054817129
412.0101147	5.856262356
417.6804322	5.670317519
423.1762505	5.495818238
428.5079897	5.331739219
433.6851638	5.177174086

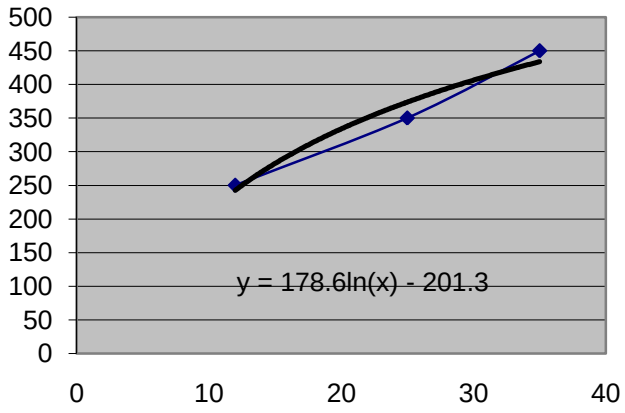

Fig.2: Graph of the Table

Thus we can see from Fig. 2 that by plotting a graph we get its corresponding equation. This equation or the table is fed in the code and a generalized code is formed that will make climber, climb and descend any staircase.

After the generalized code is fed in the AVR the vehicle is able to climb any slope of any staircase.

Fig.3 shows out project. It is a 30x30cm vehicle. A slab has been attached to the servomotor that is considered as seat and gets adjusted each time it climbs and descends a staircase.

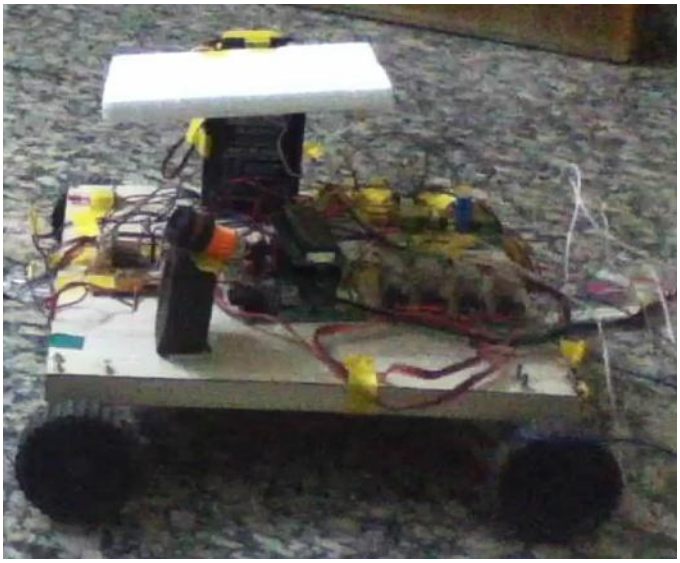

Fig.3: Picture of the prototype

Fig. 4 shows the seat getting adjusted as it is ascending the staircase.

Fig.4: Seat adjustment while climbing

VI. Conclusion

The code inserted in ATMEGA 8535 works for various other staircases too. It is a generalized code hence the seat will be always adjusted irrespective of the slope. However the vehicle should be proportionate to the staircase. The staircase climber built by us climbs and descends on a staircase and adjusts the seat perfectly and in a very stable manner.

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