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DESIGN OF LOW-COST ARM CONTROL ROBOTIC MOVING WHEELCHAIR FOR ELDERLY & PHYSICALLY DISABLED PERSONS

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ABSTRACT: This paper deals with the concept of design and implementation of a low-cost model of an arms control moving chair using ATmega8.This moving chair can move forward, backward, left, and right. This is done with the movement (tilt) of the accelerometer, and the chair stops when there is no movement of the accelerometer. The values of the three-dimensional axis of the accelerometer can be varied and adjusted. The programming has been done through AVR compilers and burned into the ATmega8.The ATmega8 receives the information from the accelerometer and transmits it back *via* RX and TX pins.ATmega8 has also been interfaced to motor driver IC-L293D, wherefrom the connections go to two motors to drive the wheels of the chair. This model has been successfully implemented at a low cost, and it will benefit physically challenged persons, especially with the poor background.

Keywords: AVR, Accelerometer, ESD, RX, TX, Amputees, Paraplegics

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INTRODUCTION: A Robot making is the joint work of electrical, mechanical, and electronic circuitry handouts, which is further guided by a computer program to implement in the practical world. The branch of technology that deals with the design, construction, operation, and manufacturing of robots as well as electronic systems included in it, for their precise control, feedback, and output processing is called robotics. In healthcare, robots have many functions, from surgery to other patient care activities.

QUICK RESPONSE CODE

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One such activity of robots is to move the elderly and physically disabled persons. This design of the robot is being discussed in this paper and has been practically implemented and tested. The control of the design is based on the programming done through AVR compilers and then programmed into ATmega8, which is further interfaced to two stepper motors and an accelerometer which moves the whole project forward, backward, left & right. This is done by tilting the accelerometer into their respective positions and the motors in the design stop only when the accelerometer is held still [1, 2].

Design Requirements of the Robotic Wheel Chair: [3] The robotic wheelchair is controlled by a microcontroller of AVR family specified as ATmega8 powered by a motor driver IC, which runs the motors. The main components used in the design are *viz.*;

1. Atmega8
2. Motor Driver IC-L239d
3. Two Bi-Directional Stepping Motors-L293d
4. LCD -16*2 for Setting Values
5. Accelerometer-Adxl335
6. AVR Board
7. 9V Battery

Flow Chart of the Design:

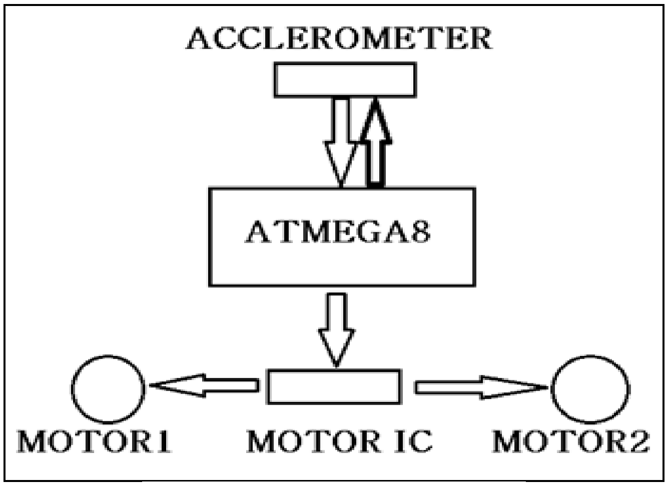

FIG. 1: DESIGN FLOW CHART

ATmega8 Features: [4] The Atmel AVR ATmega8 is a low-power CMOS 8-bit microcontroller based on the AVR RISC architecture. By executing powerful instructions in a single clock cycle, the ATmega8 achieves throughputs approaching 1MIPS per MHz, allowing the system designed to optimize power consumption versus processing speed. ATmega8 offers self-programmability for fast, secure, cost-effective in-circuit upgrades. You can even upgrade the flash memory while running your application.

The ATmega8 provides the following features:

- High-performance, Advanced RISC Architecture
- 23 Programmable I/O Lines
- 28-lead PDIP, 32-lead TQFP, and 32-pad QFN/MLF
- 8Kbytes of In-System Self-programmable Flash program memory
- 512Bytes EEPROM
- 1 Kbyte Internal SRAM
- Write/Erase Cycles: 10,000 Flash/100,000 EEPROM
- Data retention: 20 years at 85°C/100 years at 25°C(1)
- Optional Boot Code Section with Independent Lock Bits In-System Programming by On-chip Boot Program
- True Read-While-Write Operation
- Programming Lock for Software Security
- Operating Voltages: 2.7V - 5.5V (ATmega8L)
- Power Consumption at 4Mhz, 3V, 25^{0}C : Active: 3.6Ma, Idle Mode: 1.0mA, Power-down Mode: 0.5µA

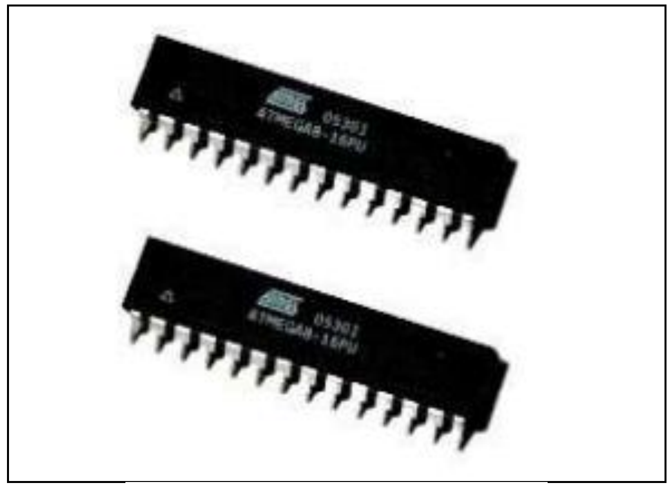

FIG. 2: ACTUAL IC OF ATMEGA8

Motor Driver IC-L293D: [5] The L293 is designed to provide bidirectional drive currents of up to 1 A at voltages from 4.5 V to 36 V. The L293D is designed to provide bidirectional drive currents of up to 600-mA at voltages from 4.5 V to 36 V. Both devices are designed to drive inductive loads such as relays, solenoids, dc, and bipolar stepping motors, as well as other high-current/high-voltage loads in positive-supply applications.

The features of this IC are:

- Wide Supply-Voltage Range: 4.5 V to 36 V
- Separate Input-Logic Supply
- Internal ESD Protection
- Thermal Shutdown
- High-Noise-Immunity Inputs
- Output Current 1 A Per Channel
- (600 mA for L293D)
- Peak Output Current 2 A Per Channel

- (1.2 A for L293D)
- Output Clamp Diodes for Inductive
- Transient Suppression (L293D).

The pin diagram of this IC is shown below;

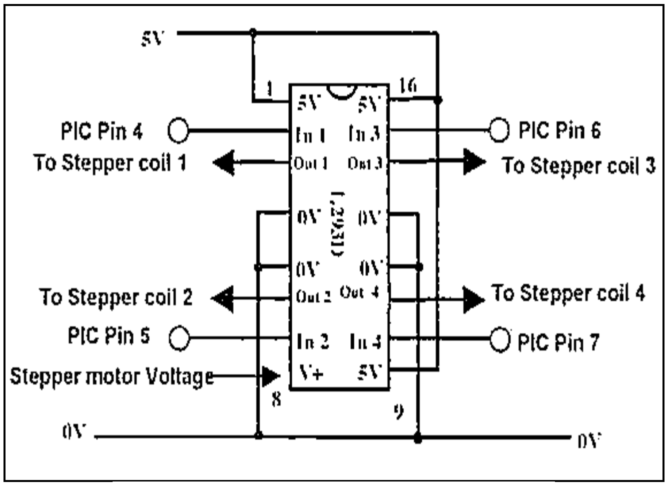

FIG. 3: PIN DIAGRAM OF IC-L293D

Accelerometer: [7]

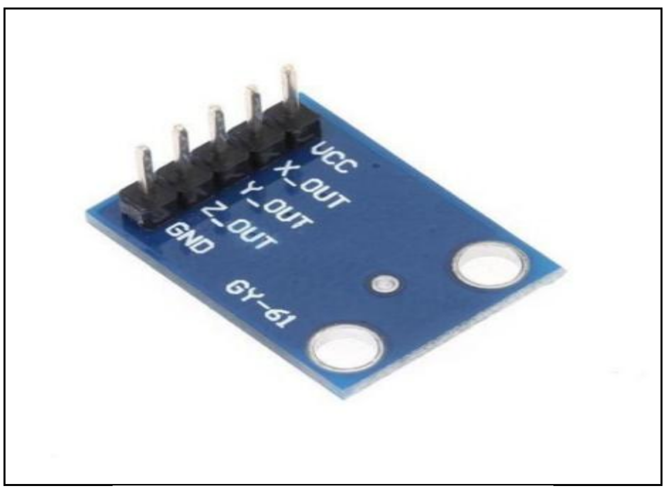

FIG. 4: ACTUAL ACCELEROMTER

The ADXL335 is a small, thin, low power, complete 3-axis accelerometer with signal conditioned voltage outputs. The product measures acceleration with a minimum full-scale range of ±3 g. It can measure the static acceleration of gravity in tilt-sensing applications, as well as dynamic acceleration resulting from motion, shock, or vibration. The user selects the bandwidth of the accelerometer using the CX, CY, and CZ capacitors at the XOUT, YOUT, and ZOUT pins. Bandwidths can be selected to suit the application, with a range of 0.5 Hz to 1600 Hz for the X and Y axes, and a range of 0.5 Hz to 550 Hz for the Z axis.

The features of this IC are:

- 3-axis sensing
- Small, low profile package
- 4 mm × 4 mm × 1.45 mm LFCSP
- Low power: 350 µA (typical)
- Single-supply operation:1.8 V to 3.6 V
- 10,000 g shock survival
- Excellent temperature stability

Setup and Working of the Design: The whole of the setup and the working can be understood in three parts; [8]

Hardware Part: The first step of the setup is to take the AVR board and fix ATmega8-IC and L293D- IC on its fixed positions on the board and then connect the stepper motors to the port pins of motor driver-IC on the board. Secondly connect the LCD 16*2 to the atmega8, so that while running the design, we will have the values of x, y, z-axis of the accelerometer and lastly we will connect x, y, z pins of the accelerometer to the PC0, PC1, and PC2.

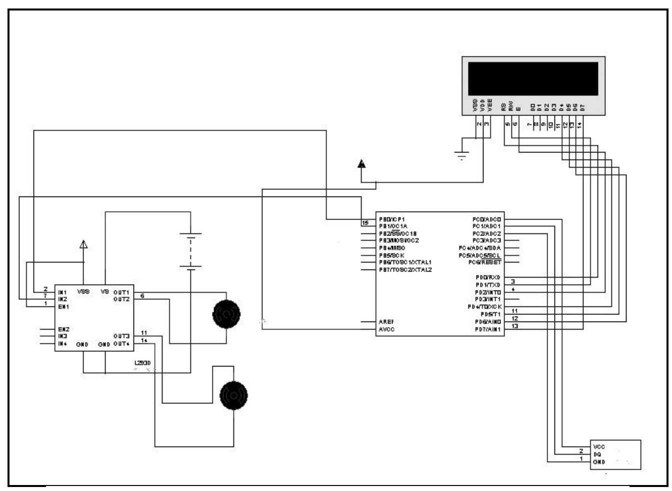

FIG. 5: CIRCUIT DIAGRAM OF THE PROJECT

The simulation of the overall circuit diagram is shown below:

Programming Part: The programming is done through the AVR studio [4]. Here we have Initially defined the three axes of the accelerometer X, Y, Z in the program and after thatwith the help of 'if' statement we have the control of moving forward, backward, left right and stop. Once the program is built, we burn the hex file of the program into the ATmega8.

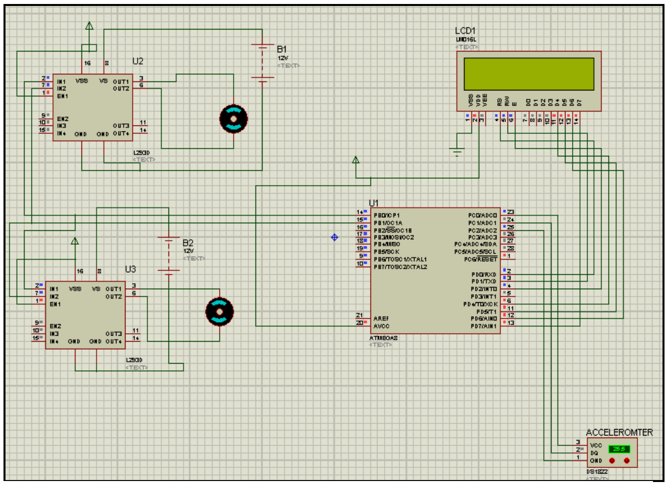

FIG. 6: WORKING CIRCUIT SETUP IN PROTEUS 7.6

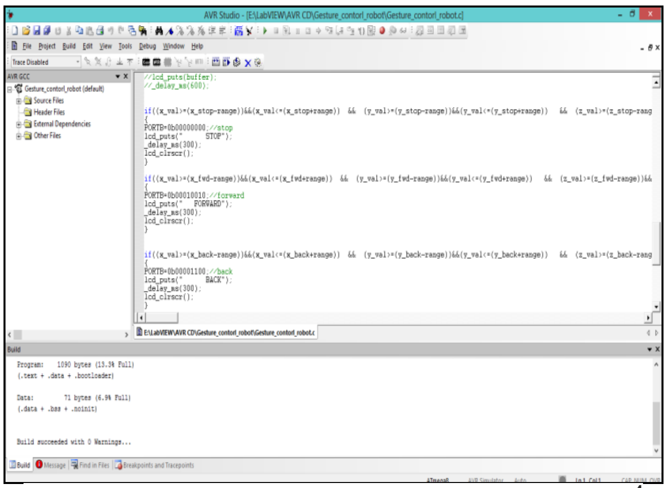

FIG. 7: PROGRAM COMPILED ON AVR STUDIO [4]

Accelerometer Movement: On providing the DC supply of 9v, we can observe the movements of the wheelchair, and hence, we can control the moving wheelchair with our hand movement. The wheelchair will move forward while we tilt slightly the accelerometer forward and similarly for the left, right, and back positions. Once we stop the accelerometer at one place, the wheelchair stops.

Applications of the Design: This project has endless applications like; when practically implemented in the industry, the cost of the chair will be less. This will benefit the persons that are physically disabled or affected by the diseases like polio, amputees, paraplegics, or any other natural accident. Elderly people can use this to move from one place to another. This model will also benefit the patients in hospitals, and other health care's also. Poor people can afford this for the cost is less.

The moving wheelchair practical implementation is similar to the figure shown below.

FIG. 8: WHEELCHAIR [6]

Future Work: In the future, we can program our design for advanced use, such that we can have non-invasive control over the chair. That means the chair will be controlled by the thinking of the human brain and will move by the actions taking place in the brain. Furthermore, we can make the chair obstacle avoider, so that if a person does not have the eyesight can use this chair too.

CONCLUSION: The design was implemented on both the hardware and the software, and it worked correctly and precisely. The software simulations are shown already above, and moreover, the handling of this chair is easy for the illiterate, old persons. In short, a layman can easily handle and keep the maintenance of this type of chair.

ACKNOWLEDGEMENT: I take this opportunity to present my votes of thanks to all those who helped me to finish this paper as well as the project. Especially my parents for their kind love and my teachers of the present institute for their support. Finally, I am much thankful to the Pharmacy department of Integral University Lucknow, which provided me a chance to present my paper in the National conference on "Novel Tools and Treatment Approaches in Health Care System."

CONFLICT OF INTEREST: Nil

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