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# Head Movement Controlled Car Driving System to Assist Physically Challenged

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***Abstract:***

A robot is the system which deals with construction, design and operation. This system is related to robot and their design, manufacture, application. Robotics is currently focused on developing systems that modularity, flexibility, redundancy, fault tolerance and some other researchers are on completely automating a manufacturing process or a task, by providing sensor based to the robot arm. Recently developing industry and man power are critical constraints for completion of task. To save human efforts the automation playing important role in the system. This system is used for regular and frequently carried work. One of the major and most commonly performed works is picking and placing of jobs from source to destination. In the earlier systems, the motion of the human hand is sensed by the robot through sensors and it follow the same. As the human travels their hand, the accelerometer also starts moving accordingly motion of the hand sensor displaces and this sensor senses object or parameter according to motion of hand.
***Keywords: Arduino uno, motor drive, MEMS sensor, RPS board, Battery.***

## 1. INTRODUCTION

Recent advancements have focused on developing gesture-based interfaces that enhance human-computer interaction, allowing users to control devices intuitively. This project aims to create a Head Movement Controlled Car Driving System to assist individuals with physical challenges, enabling them to drive independently without using their hands. The system utilizes advanced sensors and artificial intelligence to translate head movements into driving commands for steering, acceleration, and braking, making it accessible for those with conditions like quadriplegia or muscular dystrophy. Safety features, including obstacle detection and automated emergency braking, ensure a secure driving experience. This technology promotes autonomy and improves the quality of life for users, allowing them to engage in daily activities without relying on caregivers. By integrating head movement control into vehicles, the system fosters inclusivity in transportation, breaking down barriers for individuals with disabilities. Ultimately, this innovation represents a significant advancement in assistive technology, enhancing mobility and contributing to a more equitable society.

## 2. LITERATURE SURVEY

George Klein invented the first powered wheelchair (PW) for individuals with quadriplegia during World War II, emphasizing that with the right resources, they can lead fulfilling lives. Initially powered by wet cell batteries, PWs have evolved to include various chassis designs, controllers (like joysticks and sip-n-puff systems), and advanced seating systems to enhance comfort and prevent pressure sores. While Medicare limits PWs to those unable to use manual wheelchairs, many others could benefit from them.

Recent advancements in assistive technologies include hand gesture recognition systems for controlling underwater robots, utilizing accelerometers and gyroscopes to capture hand movements. Research on head movement-controlled driving systems highlights the use of sensors to translate head gestures into driving commands, enhancing mobility for individuals with physical challenges. Prototypes demonstrate the feasibility of these systems, emphasizing user-centred design and safety features like obstacle detection. Continued innovation is crucial for making these technologies accessible and empowering individuals with disabilities.

## 3. SYSTEM DESIGN

The existing standing posture model for wheelchairs is not automated, requiring manual operation, which poses challenges for individuals with physical disabilities. The proposed project aims to create an economical assembly for existing wheelchairs, enabling automated motion controlled via a smartphone, reducing the need for manual assistance. Current powered wheelchairs face limitations, particularly with voice recognition systems hindered by voice traffic. Meanwhile, head movement-controlled driving systems, like the Head-Driven Interface and Eye-Tracking technology, utilize sensors to translate head movements into vehicle commands, enhancing mobility. Despite their potential, challenges in user adaptation and system reliability remain, necessitating ongoing research and development. This project involves designing a mobile robot controlled by hand gestures using an ADXL335 accelerometer, Arduino UNO, and L293D motor driver circuit. The accelerometer detects movement, sending data to the Arduino, which controls the robot's direction based on specific axis readings. Additionally, the proposed Head Movement Controlled Car Driving System enhances mobility for individuals with physical challenges by using head-tracking cameras and gyroscopic sensors to translate head movements into driving commands. Key features include a customizable user interface, safety mechanisms like obstacle detection, and voice command functionality, promoting independence and improving the quality of life for users with disabilities.

## 4. SYSTEM ANALYSIS AND DESIGNING

Arduino is an open-source hardware and software platform that designs and manufactures single-board microcontrollers for creating digital devices and interactive objects. Its products, licensed under the GNU LGPL and GPL, allow anyone to manufacture Arduino boards and distribute software. Arduino boards feature various microprocessors, digital and analogy I/O pins, and serial communication interfaces, including USB. The platform is programmed using a C/C++ dialect and offers an integrated development environment (IDE). Founded in 2003 at the Interaction Design Institute Ivrea in Italy, Arduino aims to provide accessible tools for creating devices that interact with their environment. The name derives from a local bar.

**Fig.1: Arduino UNO**

The Arduino project began at the Interaction Design Institute Ivrea in Italy, where students initially used the costly BASIC Stamp microcontroller. In 2003, Hernando Barragán developed the Wiring platform as a Master's thesis, which included an ATmega168 microcontroller and an IDE based on Processing. Massimo Banzi and others later forked Wiring to create Arduino, aiming to provide low-cost tools for non-engineers. By mid-2011, over 300,000 official Arduinos were produced, increasing to 700,000 by 2013. Controversy arose in 2017 when former CEO Federico Musto was found to have fabricated his academic credentials. Despite plans for an Arduino Foundation, it has yet to be established. In October 2017, Arduino announced a partnership with ARM Holdings, emphasizing its commitment to independence and collaboration. While Arduino's designs are open-source, the name "Arduino" is reserved for official products, with developers requesting permission for its use in derived works.

**Fig.2: Back side of module**

Most Arduino boards feature Atmel 8-bit AVR microcontrollers (e.g., ATmega8, ATmega328) with varying flash memory and pin configurations. The 32-bit Arduino Due, based on the Atmel SAM3X8E, was introduced in 2012. Boards typically include a 5V linear regulator, a 16 MHz crystal oscillator, and are pre-programmed with a bootloader for easy program uploads. Current boards are programmed via USB using USB-to-serial adapter chips. They expose numerous I/O pins, with the Arduino Uno providing 14 digital I/O pins and six analog inputs. Many Arduino-compatible boards exist, enhancing functionality or altering form factors while maintaining compatibility with shields.

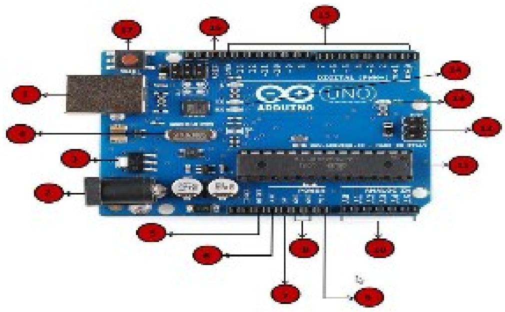

**Fig.3: Pin diagram**

**Power USB**: The Arduino board can be powered via a USB cable connected to a computer.
**Power (Barrel Jack)**: Connect the Barrel Jack to an AC mains power supply for direct power.
**Voltage Regulator**: Stabilizes the DC voltage supplied to the Arduino board.
**Crystal Oscillator**: Provides a 16 MHz frequency for time calculations.
**Arduino Reset**: Reset the board using the reset button or an external reset button connected to the RESET pin.
**Pins (3.3V, 5V, GND, Vin)**:

- **3.3V**: Supplies 3.3V output.
- **5V**: Supplies 5V output.
- **GND**: Ground pins for circuit grounding.
- **Vin**: Powers the board from an external source.

**Analog Pins**: Six analog input pins (A0-A5) read signals from analog sensors and convert them to digital values.
**Main Microcontroller**: The board's brain, typically an ATMEL microcontroller, varies by board.
**ICSP Pin**: A programming header for SPI communication, allowing for expansion of output devices.
**Power LED Indicator**: Lights up when the board is powered correctly; if off, check connections.
**TX and RX LEDs**: Indicate serial communication; TX flashes during data transmission, RX during data reception.
**Digital I/O**: 14 digital I/O pins, with 6 providing PWM output, can be configured for input or output.
**AREF**: Sets an external reference voltage (0-5V) for analog input pins.

When starting a PCB project, you'll see a yellow outline indicating the board's dimensions. After positioning parts and traces, crop the PCB to the correct size, especially if there are size constraints. The select tool allows you to move and manipulate parts, while the zoom tool focuses on selected areas. The place pad tool adds solder pads for connections, and the place component tool lets you position components in the desired orientation. The place trace tool allows you to create solid traces of varying thicknesses, and the insert corner tool helps route traces around components.

You can choose between single-sided and double-sided boards. Single-sided boards are cheaper and easier to etch but can be challenging for complex designs. Double-sided boards are more compact and easier to layout but are costlier and harder to etch. Ensure that traces on the top layer do not obstruct access to component pins, especially for larger parts like capacitors and relays.

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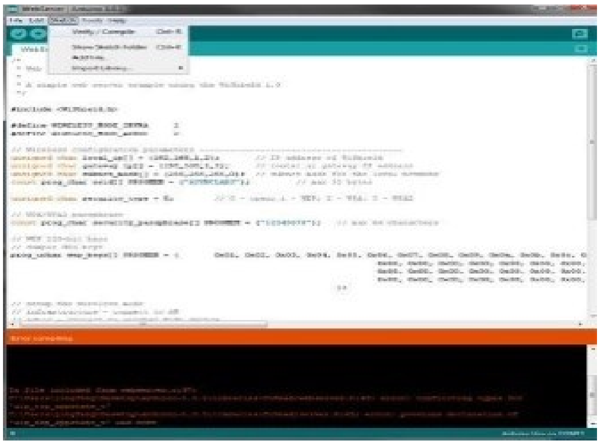

Fig.4: downloading Arduino uno

## 5. METHODOLOGY WITH WORKING

The working of the proximity sensor is in the chair that if any obstacle or any unwanted thing comes suddenly in front of the wheelchair, then it will sense that and then our chair will stop at that place only using braking system implemented in it, and it will give beep sound using buzzer also. The chair will not take that movement until the object is clear from there, but it will take all other movements other than that. Other work of buzzer is that, when user switches on the circuit then it will make to user that the circuit is on by its beep sound.

**Table 1: Methodology for Working of Car**

| Direction | Left-motor | Right-motor |
|---|---|---|
| Forward | Forward | Forward |
| Backward | Backward | Backward |
| Right | Forward | Stop |
| Left | Stop | Forward |

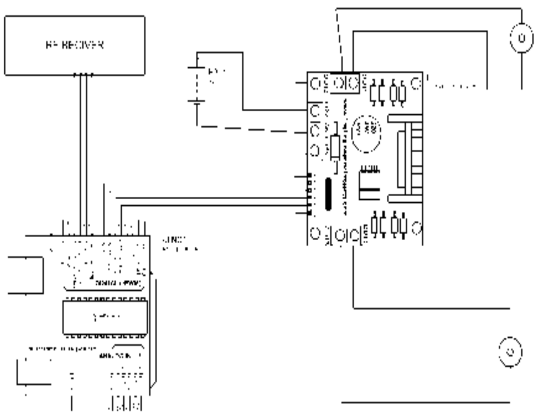

Fig.5: Working diagram.

## 6. PROJECT DISCRIPTION

**power supply:**
All digital circuits require regulated power supply. In this article we are going to learn how to get a regulated positive supply from the mains supply.

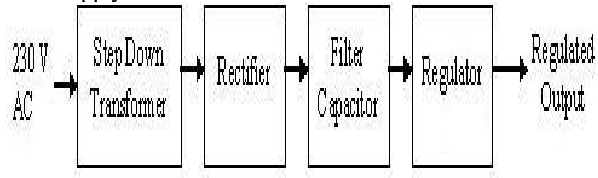


**Fig.6: Basic block diagram of a fixed regulated power supply.**

**Transformer:**

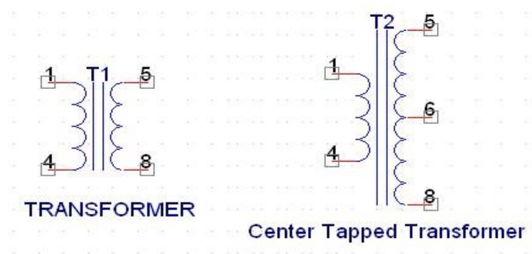


**Fig.7: Transformer.**

A transformer consists of two coils also called as WINDINGS namely PRIMARY & SECONDARY.
They are linked together through inductively coupled electrical conductors also called as CORE. A changing current in the primary causes a change in the Magnetic Field in the core & this in turn induces an alternating voltage in the secondary coil. If load is applied to the secondary then an alternating current will flow through the load. If we consider an ideal condition then all the energy from the primary circuit will be transferred to the secondary circuit through the magnetic field.
So, the secondary voltage of the transformer depends on the number of turns in the Primary as well as in the secondary.

**RECTIFIER:**
A rectifier is a device that converts an AC signal into DC signal. For rectification purpose we use a diode, a diode is a device that allows current to pass only in one direction i.e. when the anode of the diode is positive with respect to the cathode also called as forward biased condition & blocks current in the reversed biased condition.

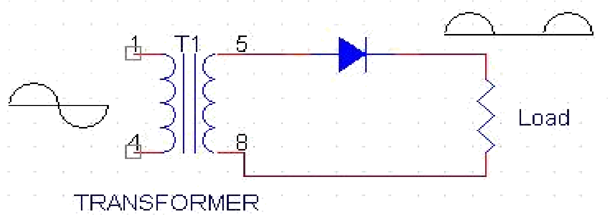


**Fig.8: Rectifier.**

**FILTER CAPACITOR:**
Even though half wave & full wave rectifier give DC output, none of them provides a constant output voltage. For this we require to smoothen the waveform received from the rectifier. This can be done by using a capacitor at the output of the rectifier this capacitor

is also called as FILTER CAPACITOR or SMOOTHING CAPACITOR or RESERVOIR CAPACITOR. Even after using this capacitor a small amount of ripple will remain.
We place the Filter Capacitor at the output of the rectifier the capacitor will charge to the peak voltage during each half cycle then will discharge its stored energy slowly through the load while the rectified voltage drops to zero, thus trying to keep the voltage as constant as possible.

**LCD DISPLAY:**

**LCD Background**:

One of the most common devices attached to a micro controller is an LCD display. Some of the most common LCDs connected to the many microcontrollers are 16x2 and 20x2 displays. This means 16 characters per line by 2 lines and 20 characters per line by 2 lines, respectively.

**Basic 16x 2 Characters LCD**

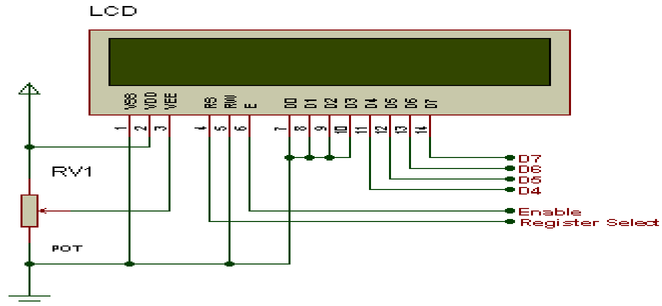


**Fig.8: LCD**

| Pin No. | Name | Description |
|---|---|---|
| Pin no. 1 | VSS | Power supply (GND) |
| Pin no. 2 | VCC | Power supply (+5V) |
| Pin no. 3 | VEE | Contrast adjust |
| Pin no. 4 | RS | Instruction input |
| Pin no. 5 | R/W | read/write to LCD |
| Pin no. 6 | EN | Enable signals |
| Pin no. 7 | D0 | Data Bus Line 0 |
| Pin no. 8 | D1 | Data Bus Line 1 |
| Pin no. 9 | D2 | Data Bus Line 2 |
| Pin no. 10 | D3 | Data Bus Line 3 |
| Pin no. 11 | D4 | Data Bus Line 4 |
| Pin no. 12 | D5 | Data Bus Line 5 |
| Pin no. 13 | D6 | Data Bus Line 6 |
| Pin no. 14 | D7 | Data Bus Line 7 |

The LCD requires 3 control lines (EN, RS, RW) and either 4 or 8 I/O lines for the data bus. In 4-bit mode, it needs 7 lines total; in 8-bit mode, it requires 11 lines. The EN line signals the LCD to receive data, while RS determines if the data is a command (low) or text (high). The RW line indicates whether data is being written (low) or read (high), though reading is rare. In 8-bit mode, the data bus consists of lines DB0 to DB7.

The ESP8266 is a low-cost Wi-Fi microchip produced by Expressive Systems, featuring a full TCP/IP stack and microcontroller capabilities. It gained popularity in 2014 with the ESP-01 module, which allows microcontrollers to connect to Wi-Fi networks and make TCP/IP connections using simple commands. Initially, documentation was scarce, but the chip's low price and minimal external components attracted many makers and hackers.
The ESP8266 supports 802.11 b/g/n Wi-Fi, Wi-Fi Direct, and has an integrated TCP/IP protocol stack. It features a +19.5dBm output power in 802.11b mode, low power consumption with a standby current of less than 1.0mW, and a power-down leakage current of less than 10µA. The chip includes 1MB of flash memory and can function as an application processor with an integrated low-power 32-bit CPU.
The ESP8266 module is versatile, capable of hosting applications or offloading Wi-Fi networking functions from another processor. Pre-programmed with an AT command set firmware, it can easily connect to Arduino devices, providing similar functionality to a Wi-Fi shield. Its cost-effectiveness and growing community support make it a popular choice for IoT projects, home automation, and various applications in medical equipment, industrial machinery, and environmental monitoring.

**D.C. MOTORS**:

A DC motor converts electrical energy into mechanical energy through the interaction of magnetic fields and current-carrying conductors. It consists of two main parts: the rotating armature and the stationary stator, which includes field coils. The armature is made of wire coils wrapped around a core with a shaft that rotates on bearings. The ends of the armature coils connect to a commutator, allowing brushes to transfer electrical current from the stationary part to the rotating part.
When voltage is applied, current flows through the field coil, creating a magnetic field. Simultaneously, current flows through the brushes into the commutator and through the armature coil, generating a magnetic field in the armature. This interaction between the magnetic fields produces torque, enabling the motor to rotate. In industrial applications, a field resistor may be added to control motor speed, enhancing the motor's functionality and efficiency.

**Fig.9: Dc motor.**

**DC MOTOR DRIVERS:**

The L293 and L293D are quadruple high-current half-H drivers designed for bidirectional drive applications. The L293 can handle up to 1 A at voltages from 4.5 V to 36 V, while the L293D supports up to 600 mA. Both are suitable for driving inductive loads like relays, solenoids, and DC motors. Inputs are TTL compatible, and drivers are enabled in pairs, with outputs active when the enable input is high. The L293 requires external clamp diodes for inductive transient suppression, while both devices feature over-temperature protection and high noise immunity.
Applications of DC motors include:

1. **Electric Trains**: DC Series Motors provide more power under load.
2. **Elevators**: Compound DC Motors are ideal for bidirectional movement.

3. **PC Fans and Drives**: Miniature motors with precision are essential.
4. **Automobile Starter Motors**: DC motors are best suited for starting engines.
5. **Electrical Machines Labs**: Commonly used in educational settings for practical learning.


**Fig.10:L293D IC**

The magnetic field in the armature and field coil causes the armature to rotate due to the attraction of unlike poles and the repulsion of like poles. As the armature turns, commutator segments move under brushes, alternating between positive and negative voltage. These switching changes the armature's magnetic field polarity, preventing it from locking with the field winding's magnetic field. Instead, the magnetic fields reinforce each other, generating additional torque to maintain rotation. When voltage is removed, the magnetic fields diminish, slowing the armature. Reapplying voltage strengthens the fields, allowing the armature to rotate again.
The rotational energy in a DC motor arises from the interaction between two magnetic fields. In a DC shunt motor, the armature features two sets of windings connected to a commutator, which maintains contact with static carbon brushes. As the commutator rotates, it energizes the armature with the appropriate polarity, ensuring that the armature and magnetic poles repel each other.
The strength of the field current directly influences the magnetic field's intensity and the armature's rotation speed. As the armature spins between the poles, it generates back electromotive force (back EMF), which acts as resistance and prevents short circuits, given the armature's low resistance (typically less than 1 Ohm). When the motor is loaded, the speed decreases, reducing back EMF and allowing more current to flow through the armature. This increase in armature current enhances the magnetic field, resulting in greater torque and improved performance under load.
When a DC Shunt Motor is overloaded, if the armature becomes too slow, the reduction of the back emf could cause the motor to burn due to heavy current flow thru the armature.
The poles and armature are excited separately, and parallel, therefore it is called a Shunt Motor.
A DC Series Motor has its field coil in series with the armature. Therefore, any amount of power drawn by the armature will be passed thru the field. As a result, you cannot start a Series DC Motor without any load attached to it. It will either run uncontrollably in full speed, or it will stop.
When the load is increased then its efficiency increases with respect to the load applied. So, these are on Electric Trains and elevators.
A Compound motor can be run as a shunt motor without connecting the serial coil at all but not vice versa.

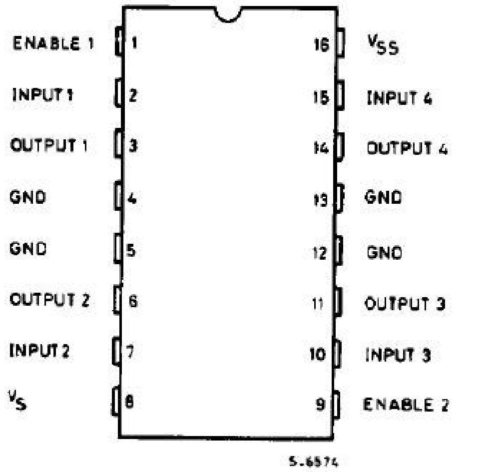


**Fig.11:L293D Pin diagram.**

## 7. EXPIREMENTAL RESULT

**ADVANTAGES:**

1. The wheelchair is ergonomically sound.
2. It is user friendly and cost effective.
3. One can take wheelchair from one place to another place without dismantling the circuits.
4. If user is unable to operate the wheelchair, in that case his/her companion can operate it within a certain range.
5. Aesthetically the design of the original Wheelchair is not changed, so that the user can use it manually also.
6. Empowers users to drive independently, reducing reliance on caregivers.
7. Utilizes natural head movements for vehicle operation, making it easier for users to adapt compared to traditional driving methods.
8. Allows personalization of control sensitivity and interface options to accommodate individual user needs and preferences.
9. Integrates advanced safety mechanisms, such as obstacle detection and automated emergency braking, to enhance user safety while driving.
10. Supports additional control methods, such as voice commands, providing flexibility for users with varying abilities.

**LIMITATIONS:**

1. Users with severe physical disabilities may have restricted head movement, making it challenging to control the vehicle effectively, which could limit the system's usability for some individuals.
2. External conditions, such as bright sunlight or glare, can affect the performance of head-tracking sensors, potentially leading to inaccuracies in detecting head movements.
3. Individuals may require significant time and training to adapt to the head movement control system, which could hinder immediate usability and confidence in driving.
4. Users may become distracted by the need to constantly monitor their head position, which could impact their focus on the road and overall driving safety.

**EXPIREMENTAL RESULT**.

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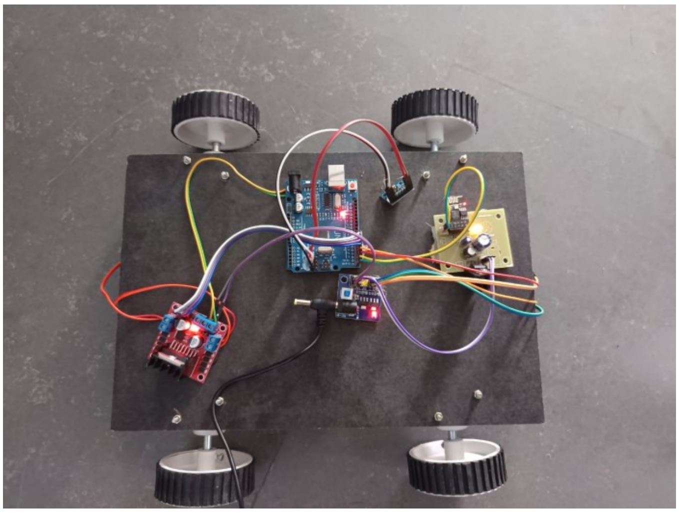

**Fig.12: Result**

## 8. CONCLUSION

The head motion-controlled wheel chair system is implemented as an example of companionship of human and machine. Independent movement is achieved with the help of the system. Errors appearing when the user makes free head motions can be reduced to a certain extent using an enable switch. It is designed to be characterized by low price and higher reliability

**FUTURE SCOPE:**
The wheelchair will provide more mobility in future and it will make people familiar with the machine. We can further improve wheelchair by making it with high accuracy. The safety measures can be included into the wheelchair like implementation of high-power sensor like Ultrasonic sensor for object detection. Artificial Intelligence can also be included to make wheelchair more technically advance.

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