

Biomedical Instrumentation (EEE1008)- J-Component

Winter Semester – 2021-22

Zeroth REVIEW

Topic: Smart Wheelchair

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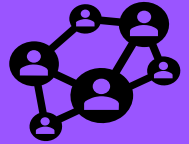
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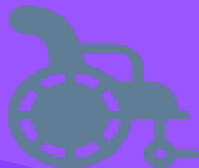
OJECTIVE

Mission

- ❖ To provide a power chair that can be used by someone who hasn't got the dexterity or mobility ,perhaps, to drive a mobility scooter due to arm, hand ,shoulder or more general disabling conditions and do not have the leg strength to propel a manual chair with their feet.

Vision

- ❖ The goal of this smart wheelchair is to enhance an ordinary powered wheelchair using sensors to perceive the wheelchair's surrounding.
- ❖ Rendering independent, productive and enjoyable living for old-aged and physically challenged people by the use of remote controlled wheelchair.



LITERATURE SURVEY



A Comprehensive Review of Smart Wheelchairs: Past , Present and Future

Jesse Leamen, and Hung M. La, Senior Member, IEEE

- ❖ Detailed discussion about SW, Human-Smart Wheelchair Interaction Model and associated technological innovations with an emphasis on the most researched areas.
- ❖ It reviews the concept and showcases the latest human-computer interface hardware, sensor processing algorithms and machine-vision innovations made in recent years.
- ❖ The rest of the paper is organized as follows :
- ❖ Present and Past achievements in PW development(Sec II) followed by a description of the international SW research effort, then it showcases the particular research in the areas of :-
 - i. **Input Methods** - Parikh et al 2007 describe the foundation for creating simple methodology for extracting user profiles ,which can be used to adequately select the best command mode for each user
 - ii. **Operating Modes**- ranges from autonomous to semi-autonomous depending on the abilities of the user and the task in hand .
 - iii. **Human factors:-**
 - a) PHYSIOLOGY
 - b) SOCIAL ISSUES-Factors that impede participation in public activities by a person with mobility impairment :Compromised body function and structure related to pain, challenging terrains, social attitude and level of personal assistance, assistive technology devices that are inappropriate or do not fit the user.
 - iv. Finally this paper lays out vision of the future of SW research and development and concludes with the discussion of changes .

Journal of Rehabilitation Research & Development (JRRD)

SMART WHEELCHAIR

(Richard c. Simpson, PhD ,ATP, Department of Rehabilitation Science and Technology , University of Pittsburgh)

- ❑ It has mainly focused on the fact that both children and adults benefit substantially from the access to a means of independent mobility whereas a segment of the disabled community finds it difficult or impossible to use wheelchairs independently.

Shodhganga: a reservoir of Indian theses

@ INFLIBNET

1. The study aims to determine the Time–motion analysis and selected physiological variables of wheelchair basketball Players. The data were collected on wheelchair basketball players in India. In the present study 17 male wheelchair basketball players of Paraplegic Rehabilitation Centre, Kirkee, Pune. All the players were orthopedic challenged.
 - ❖ Wheelchair with Automated Navigation (AGWs) -The most conventional method being sensing reflective tape markers on the floors using photo detection sensors installed on the wheelchair.
 - ❖ Another Significant feature is the Self-Transfer devices to facilitate transfer of wheelchair dependent person from one surface to another, particularly addressing transfer to a toilet commode.

Methodology

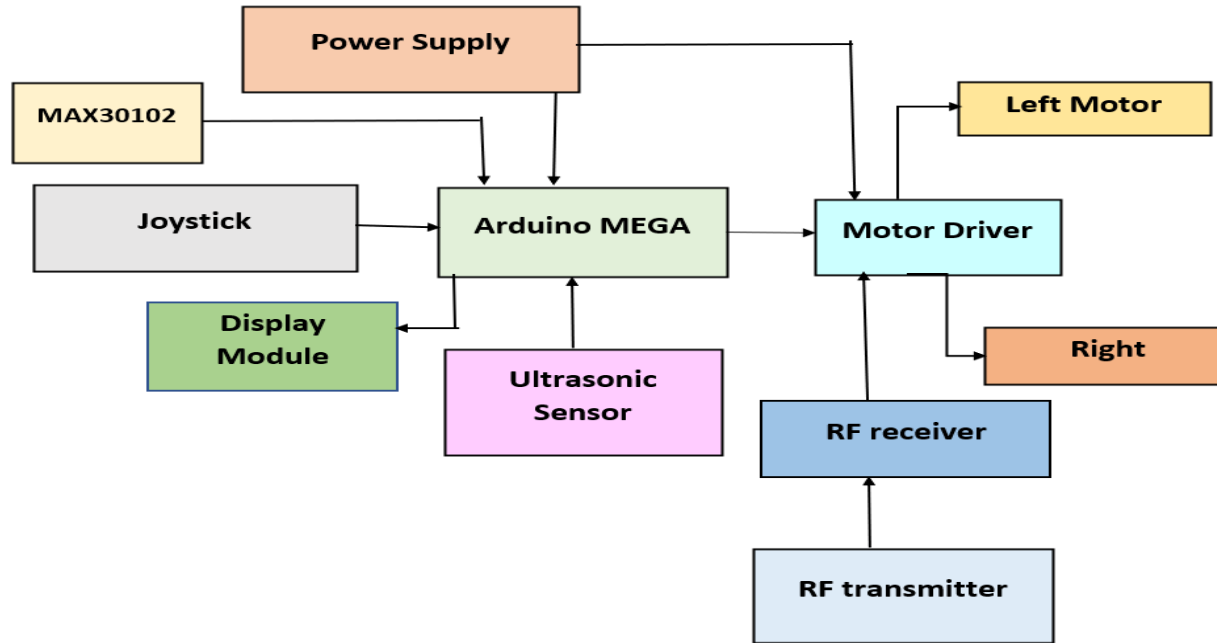
Hardware



- ❑ Hardware consists of a PWM (Pulse Width Modulation) motor driver (Cytron Overdrive) controlled using Radio frequency as well as joysticks (Potentiometer) to enable a first and third person control over the wheelchair.
- ❑ The physically handicapped or elderly people face many problems with traditional wheelchair. In our project we are using wireless and joystick based control for different needs of individual.
- ❑ Flow of command involves a user using joystick to send 10bit resolution with values between 0 and 1023 which is mapped and converted to PWM signals and the latter is sent to Cytron motor-driver to execute the movement of the chair.
- ❑ Another way of controlling involves a radio transmitter (FS-T6 In our case) which sends potentiometer values over dual channel directly to motor-driver through RF communication.
- ❑ Our design involves 6 ultrasonic sensors which can automate the movement by looking out for obstacles at 60 degrees each (similar to a SONAR used by Bats for locomotion), thereby avoiding potential collisions without the need of a third person interference giving such users the privilege to live and work independently.
- ❑ The entire system uses a 12volt battery to operate 4 DC motors with an average combined load of 21 amps. The terminal resistance across the connected cells is negligible resulting in less heat and energy loss.

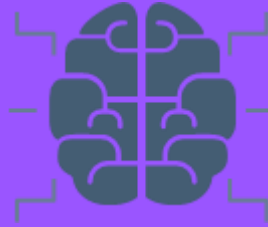


BLOCK DIAGRAM



Methodology

Software



- ❑ "PinMode" command is used to assign trigger pins of Arduino as an input or output pins for sensor or load respectively. It is executed once in a program in void setup which is logically TRUE (BOOLEAN).
- ❑ "DigitalRead" and "AnalogRead" helps in reading values from potentiometer as well as the button in the joystick which is then processed to motordriver to run motors using "DigitalWrite".
- ❑ A section of program includes a void loop which is logically true and iterates infinitely unless terminated by a break statement or an error. This section contains main body of program which needs to be repeated forever like transmitting and receiving data and values.
- ❑ The top lines of program are used as an assignment section where variables are initialized and assigned to a value so that they could be used in the entire program.
- ❑ Signals from ultrasonic sensors are fed into Arduino which is converted to the distance using standard formulae. Thus the data is processed and a rough layout of the room is established to figure out the space available for the user to navigate. If the user gets close to the object, the motion in that direction stop.
- ❑ Max30102 sensor gives heart rate and oxygen reading to arduino mega which is displayed on a binary screen using arduino HF library. The sensor is powered using a 5 volt output from microcontroller itself.

TIMELINE



"Collected and comprehended Info from various Research Papers and Journal ,Interacted with people suffering from facet joint osteoarthritis & other old age mobility issues "

Week 2

Designing and configuring layout of circuit and parts required, modelled chassis and basic framework.

Week 3



Molding all the parts, sensors, and Microcontroller to build final model, testing and observing the performance of wheelchair.

Week 5

Tweaking some components to improve performance and efficiency.

Week 7

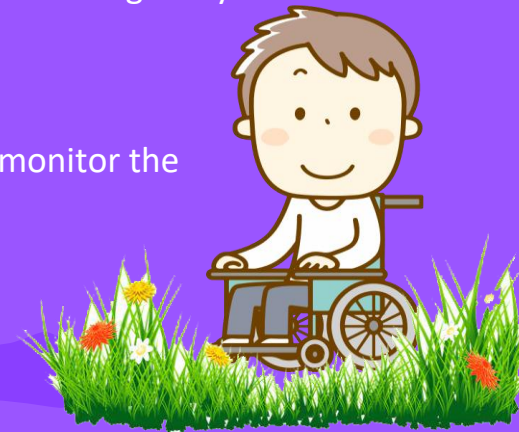


Enhancing the visual and designing aspect &.making the Final model ready for showcase.

Week 8

Novelty

- ❑ Unlike Other powered wheelchairs where user either have to go with joystick or wireless control, We have integrated both of them so that one can take advantage of joystick and Wireless at the same time according to situation.
- ❑ Lateral support provided in Wheelchair keep the user from tilting side to side.
- ❑ On board presence of Heart rate sensor and SPO2 monitor helps user to check his pulse rate and oxygen level from time to time which has become a foremost necessity during this current pandemic scenario.
- ❑ Integration of small display makes it much more user friendly to check exact readings of Health Related Sensors.
- ❑ Spotter's Strap reduces the likelihood of injuries due to rear tipping accidents or due to "running away" on down hill grades.
- ❑ To avoid any chances of collision with nearby objects ultrasonic sensors are present to monitor the distance between wheelchair and surrounding objects.
- ❑ Cushion/Foam based seating system to prevent pressure sores

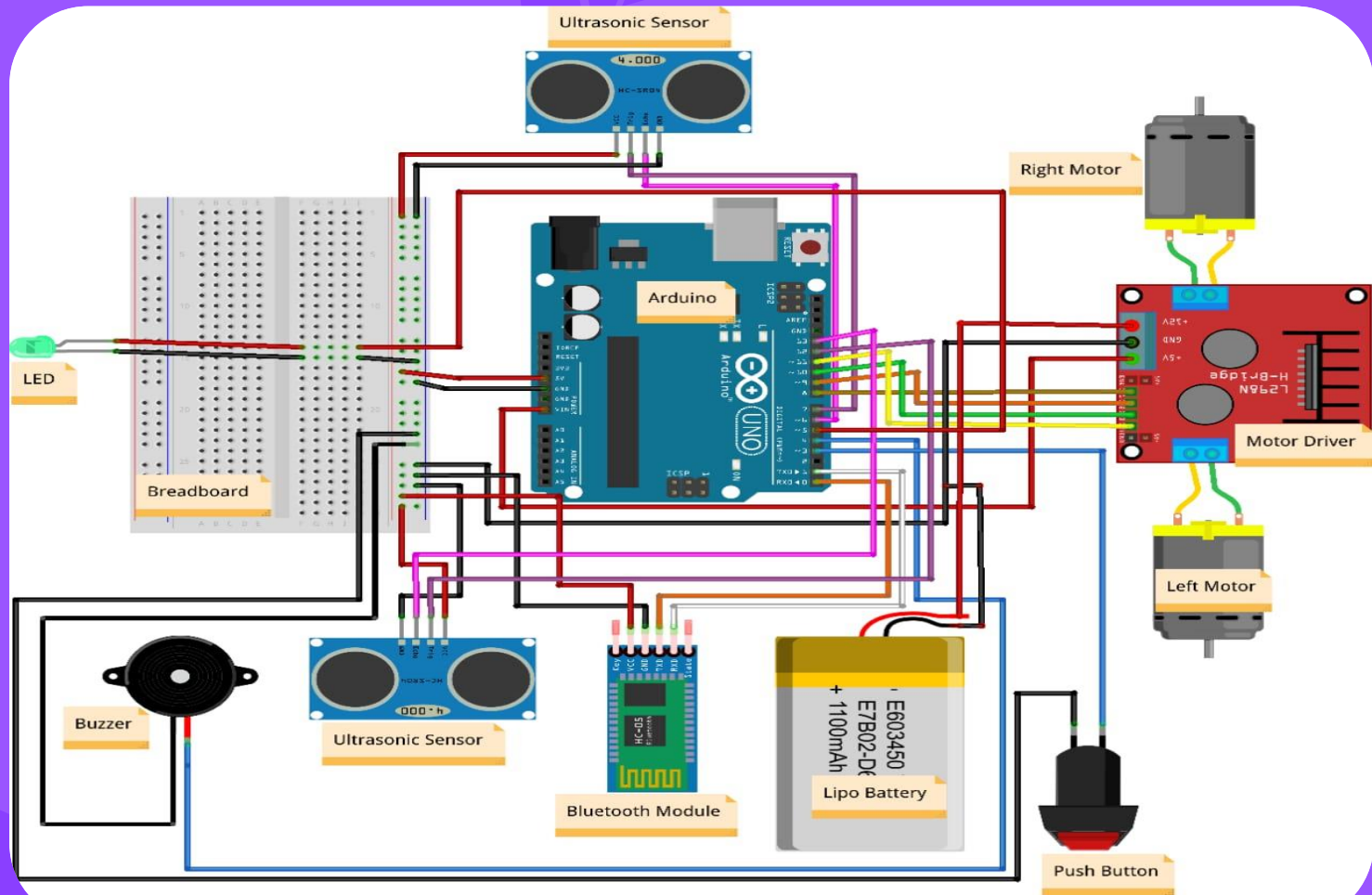


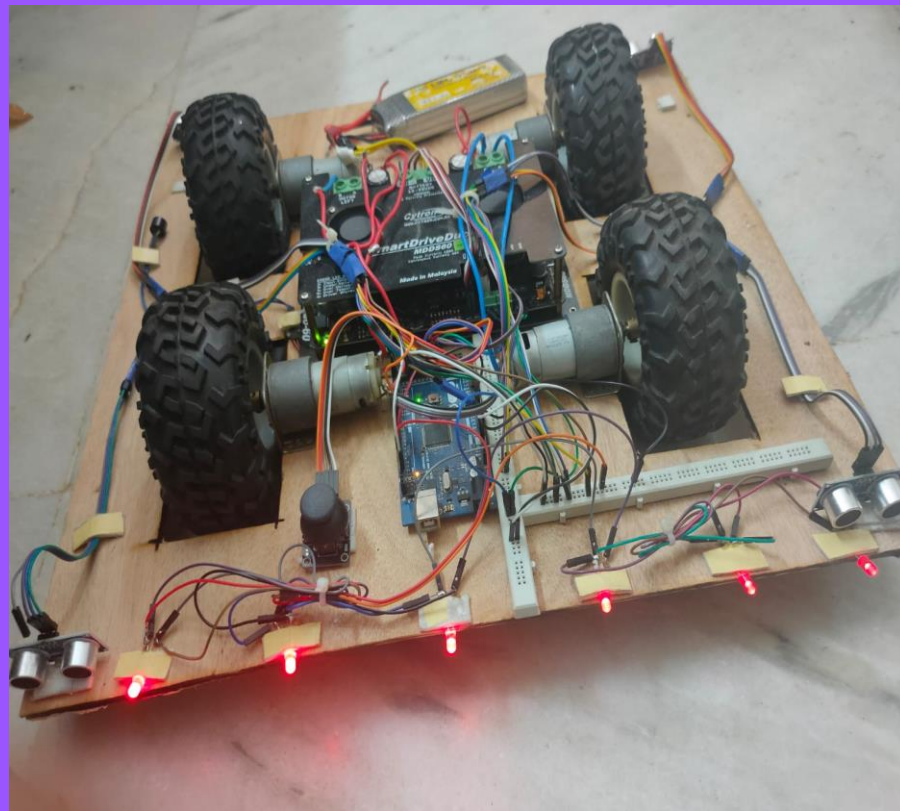
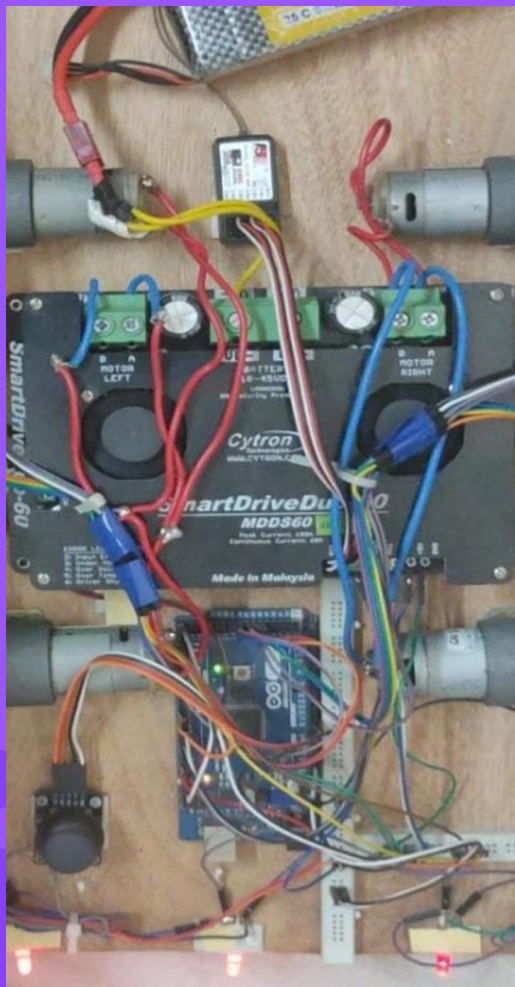
Current work progress



- ❑ For providing automatic obstacle detection, recognition of surrounding environment and collision avoidance with an angular coverage of 360 degrees, we have attached ultrasonic sensor.
- ❑ Temporarily fixed joystick which acts as an interface between wheelchair user and the machine, with in built panic alarm to provide first person control by which wheelchair user can freely move in forward, backward, turn left and right.
- ❑ Completed basic programming for motor driver to create communication bridge between motors and arduino.
- ❑ RF receiver to provide third person control over wheelchair is installed.
- ❑ We have placed Red LEDs on the rear end of the wheelchair which alerts navigator of the nearby vehicles.
- ❑ Previous version of caster and drive wheels have been replaced with new wheels having better traction as it has broad surface area, non slippery, puncture proof properties and there is no hassle to refill air as they are non-pneumatic tires.







Work to be swayed



- ❑ The designing of chair is still in initial stages, so we need to create a base support along with back rest and arm rest.
- ❑ For the live measurement of heart rate and blood oxygen level also known as SpO2 measurement we need to attach pulse oximeter sensor. The specific name of sensor is MAX30102.
- ❑ To monitor the results or live measurements of heart rate and SpO2 we have to attach an integrated display on the side of arm-rest of wheelchair.
- ❑ We have to work on Lateral Support to prevent side tilting of person, Spotter's strap to avoid rear tipping of wheelchair user.
- ❑ Lodge footrest plank for leg support to provide better comfortable reclining position to wheelchair user.

Targeted Audience

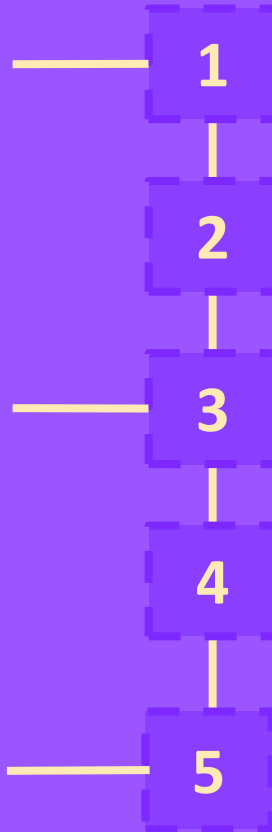


Segment of disabled person who suffer from low vision, visual field reduction, spasticity, tremors, cognitive deficits etc. Who largely rely on others for their assistance can become self-independent and perform some daily activities on their own with the help of smart wheelchair.

Elderly people or senior citizens suffering from walking impairment, due to lack of energy, joint problems like arthritis or osteoporosis.



Those who have twisted body parts and suffer from any kind of deformity in the body.



Individuals with muscular dystrophy usually exhibit contractures and experience the progressive loss of ability to walk and position themselves can use our specialized smart wheelchair.

People suffering from spinal cord injury (like Paraplegia, hypoxic-ischemic cerebral injury or other post injury patients).



REFERENCES

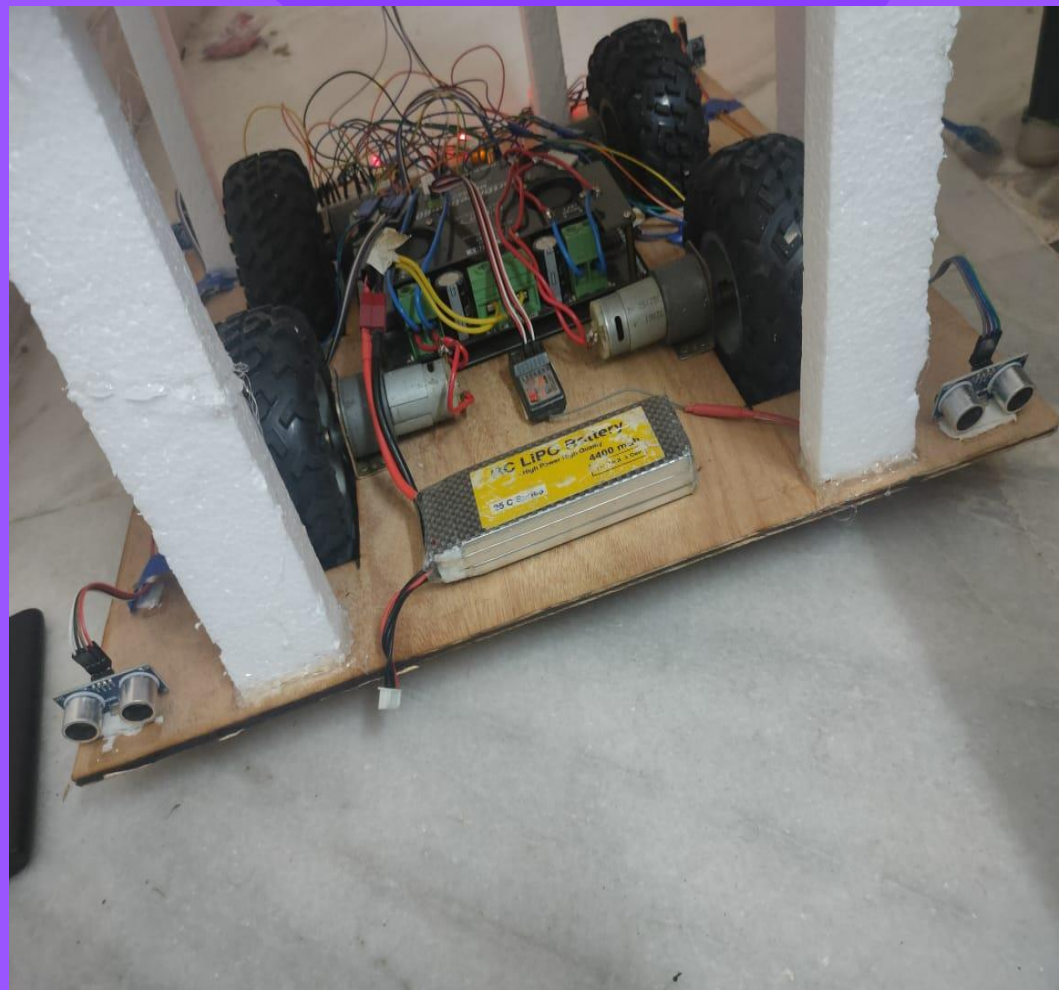
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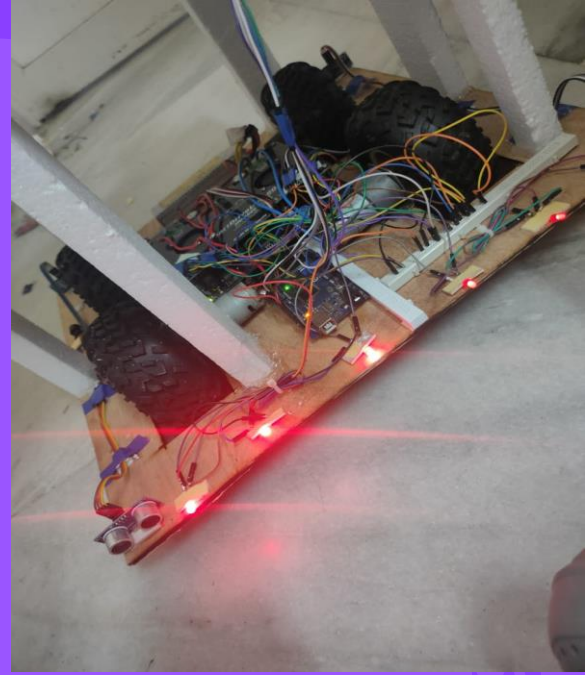


RESULTS



- ❑ The basic framework design of the wheelchair which consist of the backrest and the armrest, base support pillars are done using thermocol.
- ❑ We have fixed the joystick on the armrest of the chair which acts as an interface between wheelchair user and the machine, with in built panic alarm to provide first person control by which wheelchair user can freely move in forward, backward, turn left and right.
- ❑ We have placed Red LEDs on the rear end of the wheelchair which alerts navigator of the nearby vehicles.
- ❑ Ultrasonic sensors are attached on every corner of the wheelchair and are responding properly, we have set the threshold limit of 15cm.
- ❑ We have embedded the pulse oximeter for measuring Beats per minute and Avg. BPM with an accuracy of 60-70%.
- ❑ Motor Driver is installed and properly communicating with Arduino Mega and independently with RF transmitter by mode switching for both first person and third person control.





THANK YOU!

