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Design of Wheelchair using IoT with Hand-Gesture Control and Fall Detection

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Abstract— **The use of highly sophisticated wheelchairs is one of the major steps in the integration of people with severe physical disabilities. Driving a wheelchair in a home environment is difficult even for the average person and it is even more difficult for people with a leg disability. To improve user engagement, the system incorporates manual touch controls as an add-on to the wheelchair controls. Details were presented regarding the mechanical design, electrical and control system of the smart wheelchair.**

Keywords— ***Wheelchair, Motorized, Solar Powered, Smart Remote, Hand Gesture etc.***

I. INTRODUCTION

Wheelchairs have been used by patients with various physical disabilities to help them move around and meet their daily needs more easily. But there are cases where the movement of a wheelchair depends on another person as it does in patients who do not have the strength and arm needed to properly push the wheels forward such as the disabled, disabled, have a stroke, the elderly etc. Joystick oriented wheelchairs, which are thought to be a solution for those types of patients, can cause a variety of problems as it requires basic shoulder movement. It does not always occur in the above-mentioned types of patients. Additionally, our solution has no barriers to standing on a joystick wheelchair that you may have as it is cordless and can be worn on any hand that allows the patient to sit in a comfortable position so that they do not feel uncomfortable. This project is an effort to help people with disabilities to move independently. Therefore, in this research project, we present an example of a wheelchair-based wheelchair that can be controlled by manual touch.

The framework consists of a transmitter and a wireless receiver. For wireless transmission, the 433Mhz RF Transmitter and Receiver Unit has been used as it transmits data at speeds of up to 1Kbps - 10Kbps and the range can be adjusted as needed. The transmission unit consists of a Arduino Nano microcontroller and an accelerometer connected to a hand glove. The accelerometer sensor was used to register the location of the hand while the touch was built. This glove should be worn by the patient who allows it to move his hand properly, sending signals to the receiver unit connected to the wheelchair leading to the movement of the wheels where he wants. The receiver unit consists of motor drivers that change the voltage as required by the wheels.

Older people and the disabled are the ones who use the wheelchair in their daily lives. These people are at great risk of falling and injuring themselves. Falling unconscious can be fatal because no one knows that the incident happened on his own. If these people live alone or their families are not, it can lead to serious falls. It is important to have a quick response and recovery time in the event of a fall incident. This project introduces another wheelchair for sale as it is

expensive, easy to control and works well. The implementation and integration of the system is described in the project.

II. OBJECTIVE

• The main purpose of this project is to control the wheel using the touch of a hand, thanks to the construction of a wireless system.
• The operating system will provide the user with a good result for selecting that wireless platform as it provides open tools for this function.
• Motorists are controlled by Arduino control. In this configuration Arduino is connected via an RF transmitter and receiver application using a master-slave.
• A slave RF module is used.
• Automated Smart Wheelchair is designed and designed for people with disabilities and is powered by solar power and battery.
• Improving the wheelchair with the help of a sensor to detect user cuts.

III. PROBLEM STATEMENT

1. People with physical disabilities face problems in a wheelchair
2. A lot of energy is wasted on the patient by working with a wheelchair
3. The assistant gets tired easily by pushing the wheelchair with the patient continuously
4. Older people with disabilities experience back pain when sitting in a correctional facility.
5. Patients are unable to rest in a wheelchair and are easily injured while sleeping.
6. To reduce the risk of complications from falls, medical care should be provided immediately.

Cause of Problem:

At the root of these problems is a lack of mobility in the construction of the wheelchair. In fact, a typical wheelchair weighs 30kg or more. Double it when the patient sits on it. Therefore, it will be for people with disabilities and patients to move a wheelchair with a load. Even the assistant will feel tired pushing the wheelchair with the patient for a long time. Not only that, the wheelchair is designed to sit and not just relax. The wheelchair seat can also be adjusted. Therefore, patients should be confined to a wheelchair and placed in bed.

IV. LITERATURE REVIEW

1. Rohit singh et.al. April 2018.

• In this paper, the Smart wheelchair has gained a lot of interest in recent times. These materials are especially useful for transporting from one place to another. These devices can also be used in old age homes where the elderly have difficulty walking. Devices serve as a blessing to those who have lost their mobility.

2.Deepak Kumar et.al. 2019.

• This project implementation helps people with disabilities who are relying on their basic needs. Sometimes their attitude is not good. Then the umbrella is very easy to operate and does not require outside help. The head mat works according to the feelings of the personal situation. A foot mat is useful during rainy days. Every ordinary person can access because of this wheelchair to stand on their own if the guard has a smartphone.

3. Muhammad faiz bin abdullah et.al. 2016.

• The basic mechanism for this establishment is two DC motors that are adjusted to wheel to control seat movements such as forward, backward and side movements. Future recommendations for this project add safety features, increase vehicle speed and more control system.

4. Suraj kumar Vishwakarma et. al. 2017.

• Smart Wheel Chair is a machine-controlled device designed with the help of user instructions. This reduces human effort and the ability to drive wheelchairs. In addition it provides an opportunity for people who are visually impaired or physically disabled to move from one place to another.

5. Takashi Gomi and Ann Griffith 2014

• A brief research study on the development of autonomous wheelchairs is presented and discussed in AAI's R&D to build a series of intelligent independent wheelchairs. A standard self-control system that can be installed in easily accessible power seats that have been well-designed over the years has been developed and tested. Behavior-based approach was used to achieve sufficient board independence with minimal cost and material utilization, while achieving high efficiency, adequate safety, clarity in appearance, and enhancement.

V. BLOCK DIAGRAM

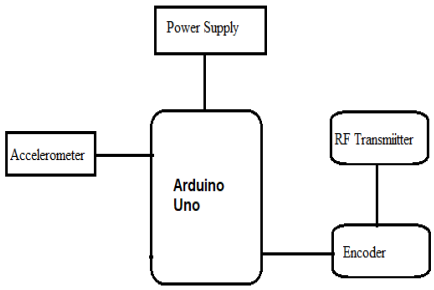


Figure 1 Block Diagram of Transmitter

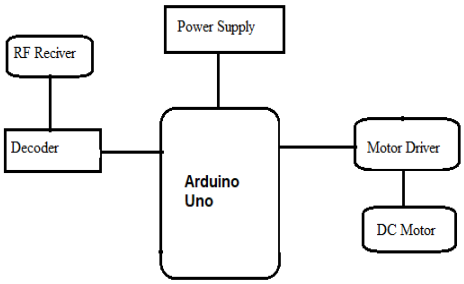
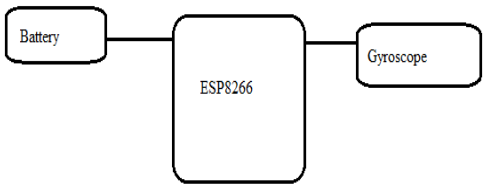


Figure 2 Block Diagram of Receiver

• In the present tense, hand gestures represent small hand or finger movements performed in a variety of ways. The accelerometer sensor is used to detect different hand gestures.

- In current work the ADX335 is used as an accelerometer sensor. The sensor can be adjusted directly with human hands or can be worn with hand gloves.
- The accelerometer supports three analog inputs and requires the conversion of a digital signal using an ADC converter to align the output of the analog signal with the RF module.
- The analog to digital conversion is done with the help of the ADC module embedded in the ATmega328 micro-controller. Based on the ADC readings associated with the accelerometer sensor, the ATmega328 will detect and determine different hand touches.



- Gyro wheel chair fall detection system is an integrated system. The first is to see the fall of a wheelchair The modified block diagram contains 1 input that was a gyroscope sensor. The sensors will be collecting data on a wheelchair and will transfer each data to the ESP 32 module.

VI. COMPONENTS

- Battery – 12v 7Ah
- Solar Panel – 12v 20w
- Arduino Uno – 328P
- RF Module
- Motor Driver Baord – L293D
- Charge Controller – 12v
- Frame
- Wires
- Adapter
- High torque DC Motor – 12v 100 rpm
- Wheels
- Others

VII. SOFTWARE SPECIFICATIONS

- Arduino Compiler
- MC Programming Language: C

VIII. CALCULATION

For Motor,
Using tong tester,
For low speed
Current drawn = 0.07A
For high Speed
Current drawn = 0.25A
For low speed of motor
Maximum Power= V x I
= 12 x 0.07
= 0.84 W
For High speed of motor
Maximum Power = V x I
= 12 x 0.25
= 3W

- Time required to charge the battery of 12V by regular A.C supply is 2hr.
- Time required to charge battery with solar panel 4 hr.
- Battery backup is of 2hr at high speed and 3 hr. at low speed.

IX. STRUCTURAL DESIGN

A general wheelchair built into the location become used to launch it because the basic infrastructure of the version. The front wheels of this wheelchair can flow in any route whether or not the rear wheels are moved or no longer by means of pushing them via hand. the primary parts or parts of a wheelchair are dc motor, wheels and many others.

- DC Motor helps rotate the tire wheel.
- Caster wheel on the the front structure that allows for easy rotation in any route.
- It's miles a simple, reliable and powerful method of shifting strength from motor to shaft.

Principal changes are being made to this building design. as opposed to the use of a standard shaft, switches are changed with DC vehicles related to the wheels. An aluminum tray is sold underneath the seat for dc gear motor and battery. single-cell dry batteries are used for electricity. The control circuitry is located underneath a chair protected with a field. And the sun panel is located on top of the EWC. Joystick mounted on EWC's right manage. energy comes from a cable that is transmitted by means of cable. This cable is going to the control unit and is hooked up to the motor. After completing the electromechanical mechanical connection, a wheelchair-installed structure is provided in Fig. 2

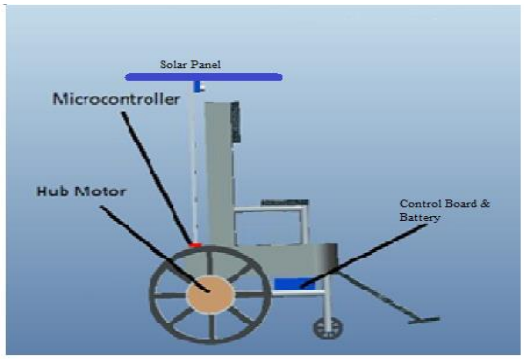


Figure 1 Wheel Chair Arrangement

X. ADVANTAGES

1. Provides affordable modes of transport for people with disabilities.
2. Solar power is free so charging is inexpensive.
3. Automatically partially automatic.
4. Low maintenance costs.
5. Solar energy is used so the process is clean and pollution is reduced.

XI. RESULT

• The aim of this project was to find another solution for the wheelchairs available in the market and to do so by building an affordable model.
• This empirical study shows how the wheelchair model benefits from the use of different wireless technology.
• The proposed "Wheelchair Touch Control Wheel" proposed program is designed to cater for patients with a variety of physical disabilities. As the wheelchair moves in accordance with each straight hand touch corresponding to its approach; complete patient relaxation kept in mind during the procedure.
• We thought this program could be a better alternative to the wheelchair model. With regard to future work, the analysis of prototype statistics and its ability to detect hand deviations in many environmental settings is planned.

Palm Movement	Function	Action
Upward	back()	Chair moves backward
Downward	front()	Chair moves forward
Left	left()	Chair moves left
Right	right()	Chair moves right
Horizontal	stop()	Chair stops

• In the implementation phase of the system, a completed flowchart and block diagram have been developed. After designing the circuit for the entire system and the system for each sub-system.
• Touch sensing method has been used by inserting a pressure sensor into the sit pad of a wheelchair. In addition, a gyroscope sensor is also used inside the wheelchair.
• Both wheelchair vision systems. If any system detects a crash, the alert system will be activated. The buzzer will open and the received data will be analyzed and sent to the IoT platform.

XII. CONCLUSION

The Touch Wheelchair is designed with two Arduino processors and controlled left, right, front, and rear. Unlike traditional design the current method is effective in transporting people with disabilities without encountering error. The requested activities and various directions are shown in Table 1. The wheelchair can be used to assist people with disabilities and the current activity is intended to assist people with disabilities who are unable to move one side of their body or slightly paralyzed and to be able to move. In the present case the wireless system is successfully developed to move the wheelchair in a variety of ways i.e., Forward, Back, Left, Right, or Sit in the Same Range and automatically stop when any obstacle is detected.

In this project, a prototype for a wheelchair based on hand control is proposed and has been developed to assist and provide a better alternative for people with severe disabilities.

• In addition to hand movements, to improve the project a variety of methods can be used such as foot, head, and even body or eye movements.
• Further research will overcome the problems of braking system in this wheelchair.
• The recharge time can be reduced by increasing the capacity of the Solar Panels.
• Vibration panels.
• Smart control with a smartphone app
• Flat area is preferred over steep slopes..

XIII. FUTURE SCOPE

• A Smart Vehicle for People with Physical and Mental Disabilities designed for this project has many benefits, but can also be improved. Here the car is controlled by a joystick. Controlling EEG signals is the best option for patients who can use the methods.
• Another proposed method is motor control by mind control. In this way one can control the same movements with mere imagination. This vehicle can be modeled in such a way that it can be easily converted into a sleep mode so that the patient feels comfortable and thus minimizes the problem of sitting in one continuous mode.

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