

# Hand Gesture Controlled Smart Robots using Wireless Sensor Network

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**Abstract** - Human Robot Interaction (HRI) interface is very much demandable for controlling the robots. The use of automatic systems has proven its worth in both commercial and non-commercial areas. A number of organizations are using automation for proper access control. This is because errors created by machines are much less than human errors. Hand gesture recognition is an effective form of non-touch instruction. In this paper, an automated system is designed for the physically challenged people to use the wheelchairs and also proposed to assist labors and to avoid human errors in public sectors like shopping malls and super markets mainly for customer's satisfaction using Hand Gestures. Based on the hand gestures using MEMS sensor, the robot will move in all directions such as forward, backward, right and left. Here accelerometer is used to detect the hand gestures. This process is done by using Wireless Sensor Network (WSN).

**KEY WORDS:** Automated system, MEMS sensor, Wireless Sensor Network (WSN), Accelerometer.

## 1. INTRODUCTION

In the development of Computer Science and sensor techniques, human-computer interaction (HCI) has a great attention in recent years. HCI is used as a strong tool for the design and use of automated system. It includes interfaces between people (Users) and computers which provides the way to develop an automated system. In the current generation the human-computer interaction application of hand gesture is being developed.

To realize the interaction between humans and machines, there are three major areas of advanced natural interaction for control of mobile robots. The first modality of interaction is a direct physical interaction that the human user to push the robot to move, many methods are developed in this area. Recently, the researches on Brain-Robot Interface (BRI) have been a wide interesting domain. In [1] a scheme is proposed for controlling a microcontroller using BRI. Another approach based motor imagery was developed by W. Song et.al [2] By exploring the activity measurement with pre - processing and processing of EEG brain signal, the first modality can be

achieved. The second modality is based on gesture to manipulate and control mobile robot, U.Rajkanna et.al developed a low cost efficient system which uses hand for controlling mobile robot which can be applied in many applications such as holding the speakers to assist dumb people [3]. In the last modality, the mobile robot is controlled in human environment via an interaction through virtual 3D lines, which are handwritten in the air by a robot user who coexists with the robot [4]. Hand Gesture controlled Robots – the robots are controlled using the hand gestures showed by the users.

## 2. HAND GESTURE CONTROLLED ROBOTS:

In this paper, a robot which was controlled by the hand gestures is designed. In the existing system, the hand gestures are some signs. But here if we tilt the controller, the robot will move in respective directions. That is if we tilt our hand in forward the robot will move in forward direction. If we tilt in backward, it will move in backward direction. If we tilt in left, the robot will turn to the left and if we tilt our hand to right, the robot will turn to the right side. Our robots is specially designed for physically challenged people and so these Hand Gestures are simple and easy to the physically challenged people to drive their wheelchairs.

## 3. LITERATURE SURVEY:

Here, they present a paper which describes the Hand Gesture Controlled robots. But these robots are controlled by some signs which are difficult to handle by the physically challenged people both to drive their wheelchairs or shopping trolleys. [1] RFID-Cloud smart cart system - Using RFID technology for billing of the purchased item includes particularly calculated PCB, wifi, and a power supply to intend the shopping trolley. [2] Smart Trolley using Smart Phone and Arduino - This application uses RFID to scan the products and sends the details to database Shopping commences by pressing start button and ends by pressing stop button provided in the trolley. [3] Innovative shopping cart - Using RFID and Zigbee technology an inexpensive RFID tag can be attached to each product and scan it with RFID reader. [4]

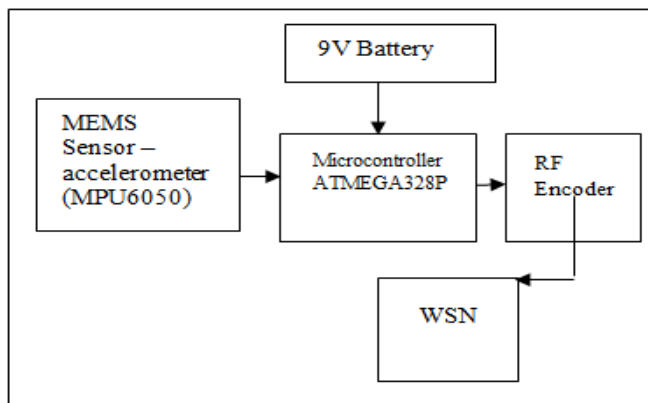
An IOT based Smart Shopping Cart for Smart Shopping - This project provides trolley to trolley communication that helps the consumers to shop with friends and family. [5] Smart shopping cart - This project mainly focused on autonomous technology to scan the products and store it in mobile database and Payment is through mobile banking.

**4. PROPOSED SYSTEM:**

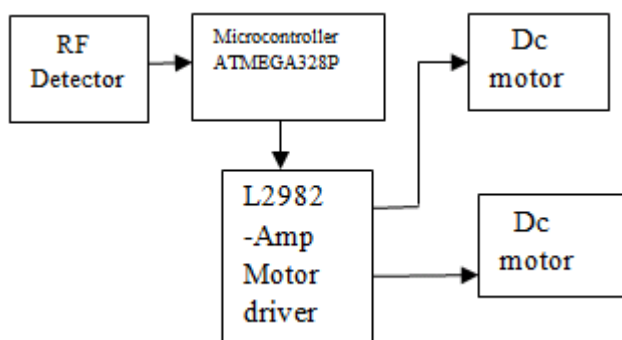
The proposed system is focused on controlling the robots using hand gestures. This process is done by using Wireless Sensor Networks (WSN). MEMS sensor i.e. Accelerometer is used to detect the hand movements showed by the users. The Transmitter is used to transmit the data detected by the accelerometer to the robot. The receiver is fixed in the robot to receive the data which was transmitted. Then it decodes the data and work according to the controller. The controller needs low current signals while the robot needs high current signals. So the driver circuit is used to convert the low current signals to high current signals. ATMEGA328P microcontroller is used in this system. RF Encoder and RF decoder is used to encode and decode the data.

**5. SYSTEM MODEL:**

**TRANSMITTER - CONTROLLER SECTION**



**RECEIVER - ROBOT SECTION**



**6. OPERATIONAL SPECIFICATIONS:**

**A. Arduino UNO:**

The fourteen digital input/output pins can be used as input or output pins by using pin Mode (), digital Read () and digital Write () functions in Arduino programming. Every pin operate at 5V and can provide or receive a 40mA current, and has an 20-50 Ohms pull up resistor which are disconnected by default. Out of these fourteen pins, some pins have specific functions as listed below:

- **Serial Pins 0 (Rx) and 1 (Tx):** Rx pins are used to receive TTL serial data and Tx pins are used to transmit TTL serial data.
- **External Interrupt Pins 2 and 3:** These pins may be designed to trigger an interrupt on an occasional worth, a rising or falling edge, or a modification in worth.
- **PWM Pins 3, 5, 6, 9 and 11:** These pins provide an 8-bit PWM output by analog Write () function.
- **SPI Pins:** These pins are used for serial peripheral interface communication.
- **In-built LED Pin 13:** This pin is connected with a integral light-emitting diode, once pin thirteen is HIGH - light-emitting diode is on and once pin thirteen is LOW.
- **Features:**
  - Microcontroller: ATmega328P
  - Operating voltage: 5V
  - Input voltage: 7-12V
  - Flash memory: 32KB
  - SRAM: 2KB
  - EEPROM: 1KB

**B. MEMS Sensor- Accelerometer:**

The measuring system could be a low power, low profile electrical phenomenon small machined measuring system that includes signal acquisition, a 1-pole low pass filter, temperature Compensation, self test. This includes a Sleep Mode that produces it ideal for hand-held battery battery-powered physics. You can use associate accelerometer's ability to sense acceleration to live a spread of things that are terribly helpful to electronic and robotic comes and designs:

- Acceleration
- Tilt and angle
- Incline
- Rotation
- Vibration
- Collision
- Gravity

Acceleration gives the data of how quickly speed changes. It act as a speed indicator meter that measures speed, associate measuring system could be a meter that measures acceleration. Accelerometers are helpful for sensing vibrations in systems or for orientation applications. Accelerometers will live acceleration on one, two, or 3 axis. 3-axis units have become additional common because the price of development for them decreases.



**Accelerometer**

#### Features:

- Low Current Consumption: 400  $\mu$ A
- Sleep Mode: 3 $\mu$ A
- Low Voltage Operation: 2.2 V – 3.6 V
- High Sensitivity (800 mV/g @ 1.5g)
- Selectable Sensitivity ( $\pm$ 1.5g,  $\pm$ 6g)
- Fast Turn on Time (0.5 ms Enable Response Time)
- Self Test for Freefall Detect Diagnosis

#### Applications:

- Self-balancing robots
- Tilt-mode game controllers
- 2edf3 Model airplane auto pilot
- Car alarm systems
- Crash detection/airbag deployment

#### C. RF Module:

RF module is an electronics device which is used to receive radio wave, transmit radio wave or transceiver radio wave on one of a number of carrier frequencies. When the module gets any motion signal, it converts the motion signal to electrical signal. Then the transmitter transmit it through receiver end, a decoder is connected through receiver end to decode the signal. It is a one way communication type and working frequency is around 433.875MHz to 434.650MHz. . It covers a certain amount

of area based on bandwidth frequency. Frequency response of RF module is 150Hz to 2.4 KHz and baud rate of the device is 300 to 4800bps.

#### D. Motor Driver (L298):

The Motor driver L298 is quadruple high-current half H drivers. It can give drive current of up to 600-mA at voltages from 4.5V to 36V. It is also configured to drive inductive loads such as solenoids, bipolar stepping motors, dc, inductive relays +and other high current or high voltage loads in positive supply applications. All inputs to the motor driver are Transistor – transistor logic compatible and each output is a complete totem-pole Drive circuit designed with a darlington transistor. It also consists of Pseudo darlington source. The motor driver is a dual bidirectional based on the very popular L298 Dual H-Bridge Motor Driver IC. This module may allow you to control two motors of up to 2A each in both directions. It is used for robotic applications.

#### 7. SOFTWARE REQUIRED:

In our project we used Embedded C is used. Embedded C is most popular programming language in software field because each processor used in electronic system is associated with embedded software. Embedded C programming plays a major role in performing various function by the processor. In embedded system programming C code is preferred over other language due to the following reason :

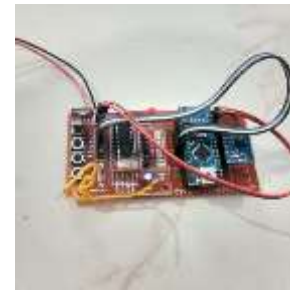
- Portability
- Scalability
- Easy to understand
- High Reliability

#### 8. WORKING PRINCIPLE:

This project is based on hand gesture techniques to control a robot wirelessly. The hand movement was sensed with the help of accelerometer. Then the analog data was passed to microcontroller which is present in the transmitting side. After the data is processed from accelerometer, microcontroller passed the data to wireless module. Then the signal goes to the receiver module. Then from receiver, microcontroller sense it through wireless module in the receiving antenna and gives the data to the motors by motor driver. Then the wheels starts to rotate in the direction according to the hand gesture command. The accelerometer will moves in X, Y and Z axis.

**8. RESULTS:**

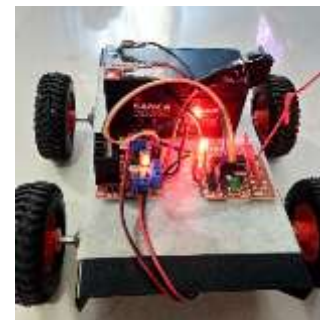
X- AXIS	>30	The robot moves in right.
X- AXIS	< -30	The robot moves in left.
Y- AXIS	>30	The robot moves forward.
Y- AXIS	< -30	The robot moves backward.



Transmitter – Control Section

**7. FUTURE WORK:**

More number of project are made on automated robot. And controlling these robots is the main issue. In our project, we tried to make it easier and simpler. We mainly focused to make the system cheap and reliable. This robot can be built in the wheelchair which helps the physically challenged people. A robotic arm can also be added in the system and which also can be operated with the help of hand gesture. Hand gesture control wheel chair can be made by the same mechanism with a bigger and high torque motor. This wireless hand gesture control system can also be helpful for controlling our home appliances and shopping trolleys.



**9. CONCLUSION:**

It is always a great challenge for us to make the things simpler and cheaper. In our project we tried to construct a low cost and efficient wireless hand gesture control robot. Mostly People used PC or remote to control the robot. But controlling the robot through the hand gesture makes it easier and simpler to control a robot. Though we tried to make it less expensive, we tried to make the robot system more reliable and simple. The advantage of our robot is that it is very easy to control. We control the system via WSN. So it consumes some time to encode and decode the data.

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Receiver – Robot section

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