Regional Competition on Innovative Experiments in Physics
(RCIEP – 2019)

Format for Submitting write up of the experiment

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Aim of the experiment:

To design a Gesture Controlled Robot: **ELECTROMON**

Learning Objectives to be achieved:

1. Operate a robot through gesture.
2. Understanding of programing.
3. Interface of transduces with microcontroller.

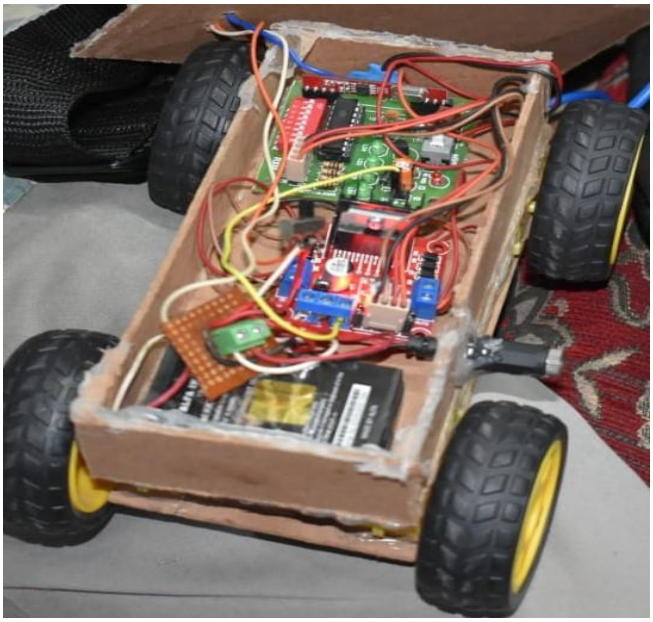
Appropriate for which grades:

Upto Post Graduation.

Concepts Covered:

- The Phenomenon of Mutual Induction.
- The use of RF (radiofrequency) in signal transmission.
- Motion control using Accelerometer sensor and various electronics component.
- Gesture recognition.

Image of the set up:



Materials Used:

1. Accelerometer.
2. RF module 433MHz.
3. BO Motors with Wheels.
4. 7805 Transistor.
5. Microcontroller ATMega328p.
6. Motor Driver L-298D.
7. Rechargeable Lithium Batteries.
8. Charging Port.
9. Switch.
10. PCB.
11. Gloves.

Innovative Features of the experiment:

- Gesture Controlled instead of using buttons.
- RF Module is being used for communication.
- Use of motion technology.
- It is cost effective and can be accessed easily.

Abstract (In around 200 words)

Today's world is surrounded with technology. Advancement in technology and making it more accessible for efficient interaction has become a very crucial part in the human development. Gesture control enable us to control machines by hands just as we can control our body parts. The ability to control machines with gestures eliminates complicated steps one needs to perform while operating a machine. Moreover, it does not require proper training to operate machine which works on complicated algorithms. Gestures provide the user with a new form of interaction that mirrors their experience in the real world. They feel natural and require neither interruption nor an additional device. Furthermore, they do not limit the user to a single point of input but instead offer various forms of interaction. It provides immense aid for people for whom mobility is a great challenge. This paper deals with the design and implementation of an accelerometer-based hand gesture-controlled robot, operated wirelessly using a small low cost, 3-axis accelerometer. A novel algorithm for gesture identification has been developed to replace the approach of conventional controlling mechanism of robots via buttons etc. by an innovative hand gesture-based controlling.

Description of the Innovative experiment: (Theory, procedure, observations, graph and result)

In this paper, an effort is made to develop new approach for controlling a bot using hand gestures. The system has been designed using microcontrollers (Arduino AT328P and RF Module 433 MHz), accelerometer MPU6050, motor driver and other basic electronic components. While working on Electromon a lot of concepts were cleared and the applications of these concepts were employed properly. These concepts include the programming of a microcontroller, driving a motor through gestures and the use of PCB in circuit designing. The proposed system can fill up the gap between human and machine interaction.

THEORY: - A gesture-controlled robot is controlled by gestures made by hand rather than use of buttons or joysticks. A transmitting device in the form of glove, containing the RF transmitter and accelerometer, is worn on hand. This glove transmits command to the robot to perform actions like moving forward, reverse, turning left, turning right and stopping. Hand gestures are assigned to each action which when performed lead to execution of desired commands.

A. Accelerometer Sensor (MPU-6050): -

Here the most important component is accelerometer. Accelerometer is a 3-axis acceleration measurement device. This device measures the static acceleration of gravity when we tilt it.

B. RF module: -

RF stand for radio frequency this module consists of two-part transmitter and receiver an encoder. An Encoder Circuit & Decoder Circuit is used along with the Transmitter & Receiver respectively.

C. Microcontroller: -

ATMEGA 328 P Arduino is used as a hardware platform. It can work on a maximum frequency of 16 MHz and it has 16 KB programmable flash memory, static RAM of 1 KB and EEPROM of 512 Bytes. It is a 40-pin microcontroller and have 32 I/O (Input/output) lines. The device supports throughout of 16 MIPS at 16 MHz and operates between 4.5-5.5 volts.

D. Motor Driver: -

The primary purpose is to supply current to the motors as it cannot be done through the microprocessors. The L298D is a 16-pin IC dedicated to control the motor. It can take input voltage between the range 6-18 Volts.

Procedure:

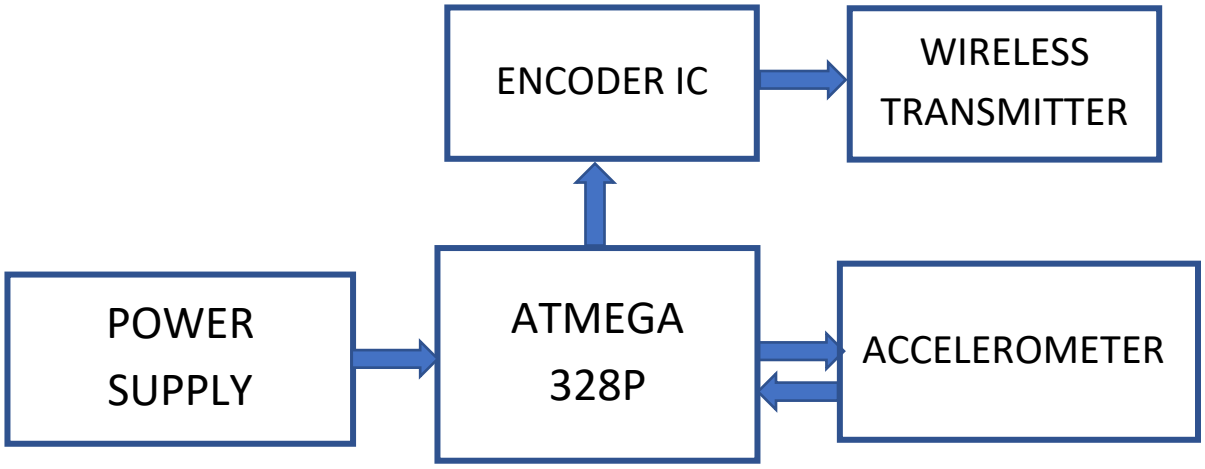


Fig. Block Diagram of Transmitting Section

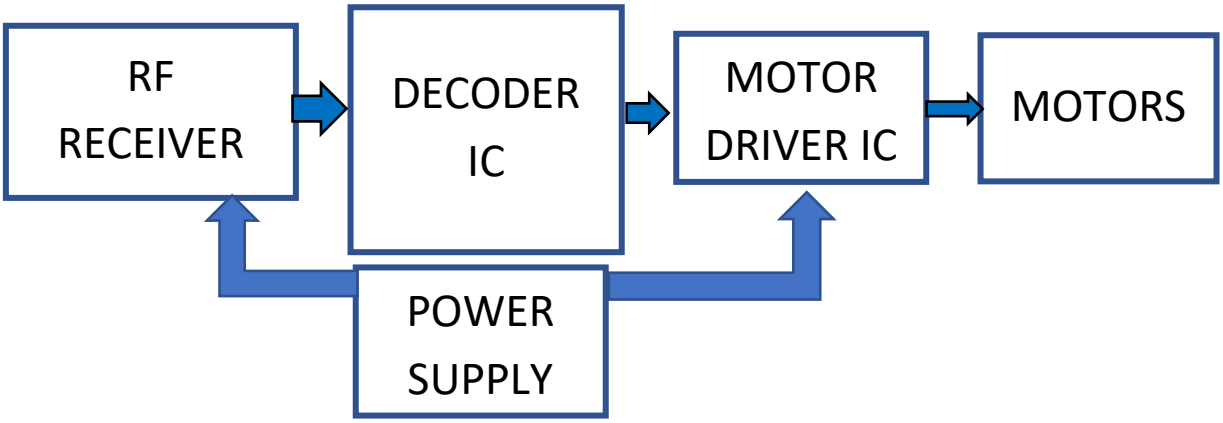


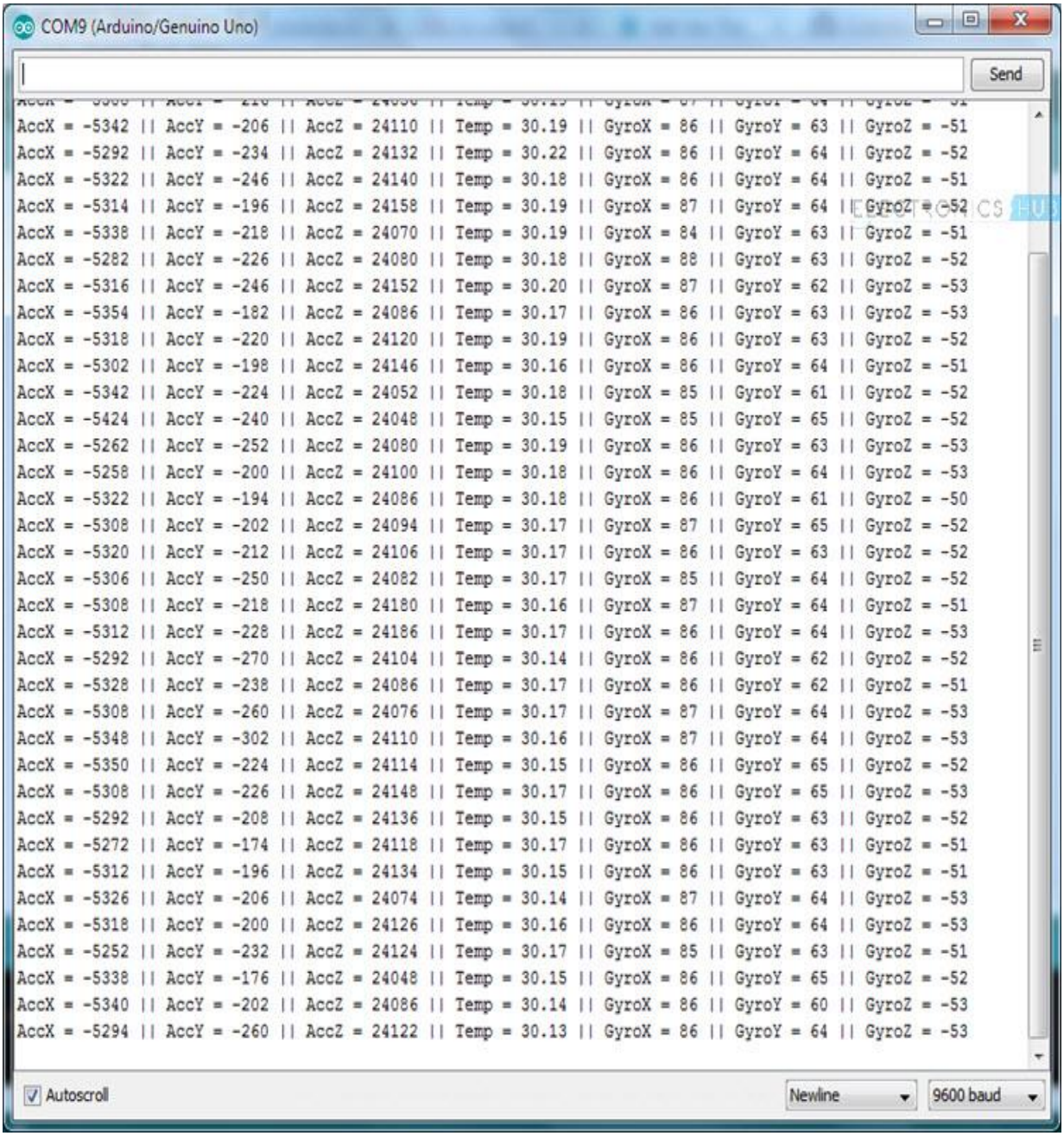
Fig. Block Diagram of Receiver Section

Obsevation:-

This Electromon design can be controlled by gestures provided the transmitter and receiver are within a range of 50-60meters. The respond recieved by Electromon is very agile.It has a battery life of nearly 2 hours under continuous operation. Due to its durable outer body, it is capable of enduring minor collisions and carrying 2-3kilograms of payload.

Callibration table of accelerometer:-

In this table directions along axis x,y and z are determined and callibrated to achieve accurate amount of tilt in the acceolerometer. This observation enables calculation of the minimum amount of tilt of hand required to change the direction of Electromon.



For Gesture Control, specific inputs are to be fed to the analog port of the Arduino and the digital output from Arduino is fed to the transmitter circuit. These inputs are given in the following table: -

Movement of hand				Input to the Arduino ports			
	Angle of tilt	Direction	Gesture Code	D3	D2	D1	D0
Stable	180°	Stop		0	0	0	0
Tilt right	34.37°	Turn Right		0	0	0	1
Tilt left	34.37°	Turn Left		0	0	1	0
Tilt back	34.37°	Backward		1	0	0	0
Tilt front	40.10°	Forward		0	1	0	0

Result: -

Gesture Controlled Robot: ELECTROMON has been designed successfully which works on the principle of Motor Control using Gestures.

Cost effectiveness and usability of the experiment

Hand gesture control is an example of companionship between man and machine in the race of man vs machine, further enhancing the technology to the next level from speech recognition and wired connections to wireless hand gestured controlled technology. There is rapid growth in application development in the field of gesture recognition system. So, in this paper, we propose a model of robot based on 'Hand Gesture Recognition utilizing hand gestures to communicate with the robot.' The low price and short setup time are some of the advantages of the system but an important limitation to consider is limited accuracy of the system. Physical hardship is avoided through the use of accelerometer as with the twist of hand. The user gets the ability and freedom to turn the robot to desired direction

Future work will build upon accurate recognition of desired gestures. There are two possible ways to achieve the desired accuracy. Firstly, by implementation of a gyroscope in the system, in order to separate the acceleration due to gravity from inertial acceleration. Secondly, by installing a GPS in the

system to track the position of ROBOT. The use of more accelerometers to the arms is another possibility.

Some more Applications

The applications of accelerometer-based gesture-controlled robot include

- It can be used for segregation of garbage and remove toxic waste, sensitive to human skin.
- It can be used for surveillance.
- It can be used in military for launching weapons.
- It can be used in the wheelchairs of differently abled people.
- It can be also used for recreation purpose like gaming, robot racing etc.