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Implementation of Embedded Human Control of Robots Using MEMS

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Abstract- **The paper describes the MEMS based Gesture Controlled Robot. The robot can be controlled by human hand gestures relatively than an ordinary switch. The operation is based on the moment of the hand gestureaction signs made through hand movement. The MEMS sensor with the Myoelectric interface is used for the convenient operations. These Interfaces between these sensors are controlled by a software program which is interfaced with a microcontroller system. The experimentations prove that the gesture recognition formula is very competent and it improves the recognition in a better way and is placed in a small cabinet. This technique used in robots can interact with humans in a natural way. Hence our interest is in the hand motion based robust MEMS gesture controlled robot interface.**

Index Terms- **ZigBee, Embedded, MEMs, Gesture, Robotics.**

I. INTRODUCTION

The objective of this paper is to build a gesture controlled robot that can be controlled by gesture wirelessly. User is able to control movements of the Robot by wearing the controller glove and performing predefined gestures.This project provides a basic platform for many potential applications such as wireless controlled car racing games, gesture human-machine interfacing, and etc.

Technology is the word coined for the ractical application of scientific knowledge in the industry. The advancement in technology cannot be justified unless it is used for leveraging the user's purpose. Technology, is today, imbibed for accomplishment of several tasks of varied complexity, in almost all walks of life. The society as a whole is exquisitely dependent on science and technology. Technology has played a very significant role in improving the quality of life. One way through which this is done is by automating several tasks using complex logic to simplify the work.Gesture recognition has been a research area which received much attention from many research communities such as human computer interaction and image processing. The increase in human machine interactions in our daily lives has made user interface technology progressively more important.

Physical gestures as intuitive expressions will greatly ease the interaction process and enable humans to more naturally command computers or machines. Now a day's robots are controlled by remote or cell phone or by direct wired connection. If we thinking about cost and required hardware's all this things increases the complexity,especially for low level application. For example, in telerobotics, slave robots have been demonstrated to follow especially for low level application.

II. ZIGBEE

ZigBee is the most popular industry wireless mesh networking standard for connecting sensors, instrumentation and control systems. ZigBee, a specification for communication in a wireless personal area network (WPAN), has been called the "Internet of things." Theoretically, your ZigBee-enabled coffee maker can communicate with your ZigBee-enabled toaster. ZigBee is an open, global, packet-based protocol designed to provide an easy-to-use architecture for secure, reliable, low power wireless networks. ZigBee and IEEE 802.15.4 are low data rate wireless networking standards that can eliminate the costly and damage prone wiring in industrial control applications. Flow or process control equipment can be place anywhere and still communicate with the rest of the system. It can also be moved, since the network doesn't care about the physical location of a sensor, pump or valve.

Its low power consumption limits transmission distances to 10–100 meters line-of-sight, depending on power output and environmental characteristics. Zigbee devices can transmit data over long distances by passing data through a mesh network of intermediate devices to reach more distant ones. Zigbee is typically used in low data rate applications that require long battery life and secure networking (Zigbee networks are secured by 128 bit symmetric encryption keys.) Zigbee has a defined rate of 250 kbit/s, best suited for intermittent data transmissions from a sensor or input device.

The ZigBee RF4CE standard enhances the IEEE 802.15.4 standard by providing a simple networking layer and standard application profiles that can be used to create interoperable multi-vendor consumer electronic solutions. The benefits of this technology go far beyond, ZigBee applications include:

- Home and office automation
- Industrial automation
- Medical monitoring
- Low-power sensors
- HVAC control

ZigBee is poised to become the global control/sensor network standard. It has been designed to provide the following features:

- ✓ Low power consumption, simply implemented.
- ✓ Users expect batteries to last many months to years. Bluetooth has many different modes and states depending upon your latency and power requirements such as sniff, park, hold, active, etc. ZigBee/IEEE 802.15.4 has active (transmit/receive) or sleep.
- ✓ Even mains powered equipment needs to be conscious of energy. ZigBee devices will be more ecological than its predecessors saving megawatts at it full deployment.

A.Low cost (device, installation, maintenance):

Low cost to the users means low device cost, low installation cost and low maintenance. ZigBee devices allow batteries to last up to years using primary cells (low cost) without any chargers (low cost and easy installation). ZigBee’s simplicity allows for inherent configuration and redundancy of network devices provides low maintenance.

B.High density of nodes per network:

ZigBee’s use of the IEEE 802.15.4 PHY and MAC allows networks to handle any number of devices. This attribute is critical for massive sensor arrays and control networks.

ZigBee’s protocol code stack is estimated to be about 1/4th of Bluetooth’s or 802.11’s. Simplicity is essential to cost, interoperability, and maintenance. The IEEE 802.15.4 PHY adopted by ZigBee has been designed for the 868 MHz band in Europe, the 915 MHz band in N America, Australia, etc; and the 2.4 GHz band is now recognized to be a global band accepted in almost all countries.

C.Working of zigbee:

ZigBee basically uses digital radios to allow devices to communicate with one another. A typical ZigBee network consists of several types of devices. A network coordinator is a device that sets up the network, is aware of all the nodes within its network, and manages both the information about each node as well as the information that is being transmitted/received within the network. Every ZigBee network must contain a network coordinator. Other Full Function Devices (FFD's) may be found in the network, and these devices support all of the 802.15.4 functions. They can serve as network coordinators, network routers, or as devices that interact with the physical world.

The final device found in these networks is the Reduced Function Device (RFD), which usually only serve as devices that interact with the physical world. As mentioned above several topologies are supported by ZigBee, including star, mesh, and cluster tree. As can be seen in above star topology is most useful when several end devices are located close together so that they can communicate with a single router node. That node can then be a part of a larger mesh network that ultimately communicates with the network coordinator. Mesh networking allows for redundancy in node links, so that if one node goes down, devices can find an alternative path to communicate with one another.

III.WIRELESS COMMUNICATION

All wireless communication systems have the following components:

- Transmitter
- Receiver
- Antennas
- Path between the transmitter and the receiver.

In short, the transmitter feeds a signal of encoded data modulated into RF waves into the antenna. The antenna radiates the signal through the air where it is picked up by the antenna of the receiver. The receiver demodulates the RF waves back into the encoded data stream sent by the transmitter.

MEMS based Hand Gesture controlled robot - Transmitter:

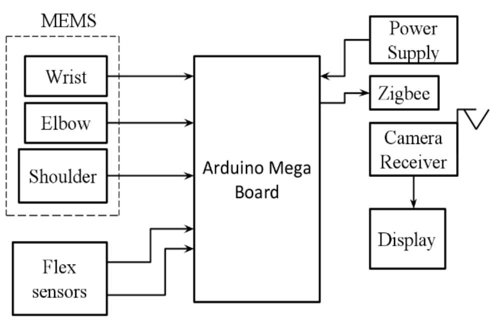


Fig 1. Transmitter Of Mems Based Hand Gesture Controlled Robot

MEMS based Hand Gesture controlled robot - Receiver:

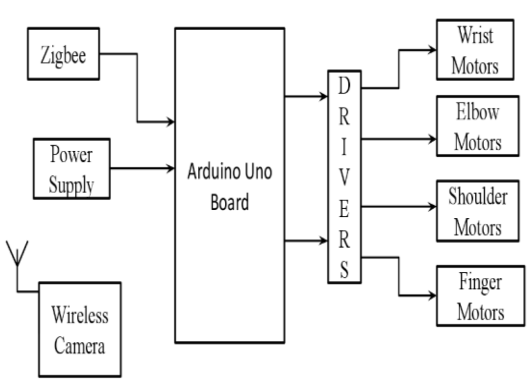


Fig 2. Reciever Of Mems Based Hand Gesture Controlled Robot

A.Transmitter and Receiver:

The power output of the transmitter and the sensitivity of the receiver are determining factors of the signal strength and its range. Other factors include any obstacles in the communication path that cause interference with the signal. The higher the transmitter's output power, the longer the range of its signal. On the other side, the receiver's sensitivity determines the minimum power needed for the radio to reliably receive the signal. These values are described using dBm, a relative measurement that compares two signals with 1 milliwatt used as the reference signal. A large negative dBm number means higher receiver sensitivity.

B.Wireless Standards:

The demand for wireless solutions continues to grow and with it new standards have come forward and other existing standards have strengthened their position in the marketplace. This section compares three popular wireless standards being used today and lists some of the design considerations that differentiate them. Of the three ISM frequency bands only the 2.4 GHz band operates worldwide.

The 868 MHz band only operates in the EU and the 915 MHz band is only for North and South America. However, if global interoperability is not a requirement, the relative emptiness of the 915 MHz band in nonEuropean countries might be an advantage for some applications. For the 2.4 GHz band, IEEE 802.15.4 specifies communication should occur in 5 MHz channels ranging from 2.405 to 2.480 GHz.

Comparison of Wireless Standards			
Wireless Parameter	**Bluetooth**	**Wi-Fi**	**ZigBee**
Frequency band	2.4 GHz	2.4 GHz	2.4 GHz
Physical/MAC layers	IEEE 802.15.1	IEEE 802.11b	IEEE 802.15.4
Range	9 m	75 to 90 m	Indoors: up to 30 m Outdoors (line of sight): up to 100 m
Current consumption	60 mA (Tx mode)	400 mA (Tx mode) 20 mA (Standby mode)	25-35 mA (Tx mode) 3 μA (Standby mode)
Raw data rate	1 Mbps	11 Mbps	250 Kbps

Protocol stack size	250 KB	1 MB	32 KB 4 KB (for limited function end devices)
Typical network join time	>3 sec	variable, 1 sec typically	30 ms typically
Interference avoidance method	FHSS (frequency-hopping spread spectrum)	DSSS (direct-sequence spread spectrum)	DSSS (direct-sequence spread spectrum)
Minimum quiet bandwidth required	15 MHz (dynamic)	22 MHz (static)	3 MHz (static)
Maximum number of nodes per network	7	32 per access point	64 K
Number of channels	19	13	16

Table 1. Comparison Of Wireless Standards

IV.HARDWARE REQUIREMENTS

- Arduino uno (AT Mega 328P)
- Arduino mega (AT Mega 2560)
- MEMS
- Zigbee
- Motor driver
- Motors
- Power supply

SOFTWARE REQUIREMENTS

- Embedded C
- Arduino IDE
- Flash magic

A. Arduino uno (AT Mega 328P):

The ATmega328 is a single-chip microcontroller created by Atmel in the mega AVR family.The Arduino Uno is a microcontroller board based on the ATmega328 . It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz ceramic resonator, a USB connection, a power jack, an ICSP header, and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with a AC-to-DC adapter or battery to get started.

The Uno differs from all preceding boards in that it does not use the FTDI USB-to-serial driver chip. Instead, it features the Atmega16U2 (Atmega8U2 up to version R2) programmed as a USB-to-serial converter. The Uno board has a resistor pulling the 8U2 HWB line to ground, making it easier to put into DFU mode.

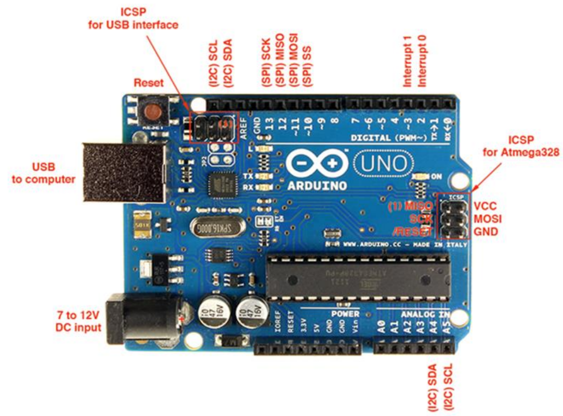


Fig 3. Arduino Uno (At Mega 328p)

B.*Memory:*

The ATmega328 has 32 KB (with 0.5 KB used for the bootloader). It also has 2 KB of SRAM and 1 KB of EEPROM

C.Input and Output:

Each of the 14 digital pins on the Uno can be used as an input or output, using pinmode,digitalwrite , and digitalread functions. They operate at 5 volts. Each pin can provide or receive a maximum of 40 mA and has an internal pull-up resistor (disconnected by default) of 20-50 kOhms. In addition, some pins have specialized functions:

- Serial: 0 (RX) and 1 (TX). Used to receive (RX) and transmit (TX) TTL serial data. These pins are connected to the corresponding pins of the ATmega8U2 USB-to-TTL Serial chip.
- External Interrupts: 2 and 3. These pins can be configured to trigger an interrupt on a low value, a rising or falling edge, or a change in value. See the attach Interrupt() function for details.
- PWM: 3, 5, 6, 9, 10, and 11. Provide 8-bit PWM output with the analog Write() function.
- SPI: 10 (SS), 11 (MOSI), 12 (MISO), 13 (SCK). These pins support SPI communication using the SPI library.
- LED: 13. There is a built-in LED connected to digital pin 13. When the pin is HIGH value, the LED is on, when the pin is LOW, it's off.

D.Power supply :

The Power Supply is a Primary requirement for the project work. The required DC power supply for the base unit as well as for the recharging unit is derived from the mains line. For this purpose center tapped secondary of 12V-012V transformer is used. From this transformer we getting 5V power supply. In this +5V output is a regulated output and it is designed using 7805 positive voltage regulator. This is a 3 Pin voltage regulator, can deliver current up to 800 milliamps.

Rectification is a process of rendering an alternating current or voltage into a unidirectional one. The component used for rectification is called 'Rectifier'. A rectifier permits current to flow only during positive half cycles of the applied AC voltage. Thus, pulsating DC is obtained to obtain smooth DC power additional filter circuits required.

The rectified Output is filtered for smoothening the DC, for this purpose capacitor is used in the filter circuit. The filter capacitors are usually connected in parallel with the rectifier output and the load. The AC can pass through a capacitor but DC cannot, the ripples are thus limited and the output becomes smoothed. When the voltage across the capacitor plates tends to rise, it stores up energy back into voltage and current. Thus, the fluctuation in the output voltage is reduced considerable.

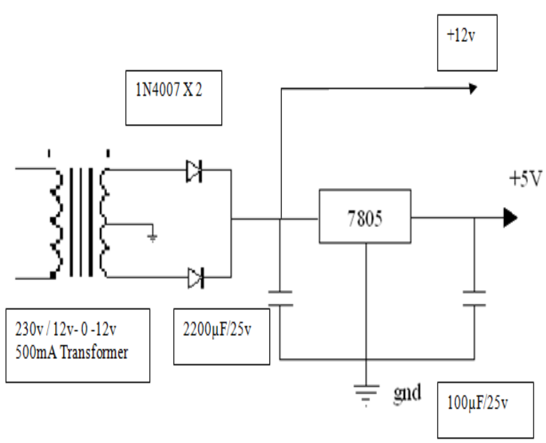


Fig 4. Circuit Diagram Of Power Supply

E.Motor drivers:

A motor driver is an integrated circuit chip which is usually used to control motors in autonomous robots. Motor driver act as an interface between Arduino and the motors. The most commonly used motor driver IC's are from the L293 series such as L293D, L293NE, etc. These ICs are designed to control 2 DC motors simultaneously. L293D consist of two H-bridge. H-bridge is the simplest circuit for controlling a low current rated motor. We will be referring the motor driver IC as L293D only. L293D has 16 pins.

We discuss about L293D motor driver working for motors. The L293 and L293D are quadruple high-current half-H drivers. Here we learn about hybrid bridges (H-BRIDGE). The h-bridges which are mainly used in change of polarities. There are two polarities in every motor. In L293D two h-bridges are present. Four transistors are present in each h-bridge. If we give logic bits 1, 0 then current flow is Vcc to motor positive after that motor positive to negative and then flows to ground. Then motor rotates in one direction. We change the logic bits as 0, 1 then current flow is Vcc to motor negative after that motor negative to positive and then flows to ground.

Then motor rotate in opposite direction. If we give logic bits 1, 1 then Vcc and ground are short. So motor does not rotate. If we give logic bits 0, 0 then motor does not start. Because The L293 is designed to provide bidirectional drive currents of up to 1 A at voltages from 4.5 V to 36 V. The L293D is designed to provide bidirectional drive currents of up to600-mA at voltages from 4.5 V to 36 V. Both devices are designed to drive inductive loads such as relays, solenoids, dc and bipolar stepping motors, as well as other high-current/high-voltage loads in positive-supply applications. All inputs are TTL compatible.

Each output is a complete totem-pole drive circuit, with a Darlington transistor sink and a pseudo-Darlington source. Drivers are enabled in pairs, with drivers 1 and 2 enabled by 1,2EN and drivers 3 and 4 enabled by 3,4EN. When an enable input is high, the associated drivers are enabled and their outputs are active and in phase with their inputs. When the enable input is low, those drivers are disabled and their outputs are off and in the high-impedance state. With the proper data inputs, each pair of drivers forms a full-H (or bridge) reversible drive suitable for solenoid or motor applications.

V.MEMS (MYOELECTRIC INTERFACE)

Micro electro mechanical systems (MEMS) are small integrated devices or systems that combine electrical and mechanical components. Their size range from the sub micrometer (or sub micron) level to the millimeter level and there can be any number, from a few to millions, in a particular system. MEMS extend the fabrication techniques developed for the integrated circuit industry to add mechanical elements such as beams, gears, diaphragms, and springs to devices. Examples of MEMS device applications include inkjet-printer cartridges, accelerometers, miniature robots, micro engines, locks, inertial sensors, micro transmissions, micro mirrors, micro actuators, optical scanners, fluid pumps, transducers and chemical, pressure and flow sensors. Many new applications are emerging as the existing technology is applied to the miniaturization and integration of conventional devices.

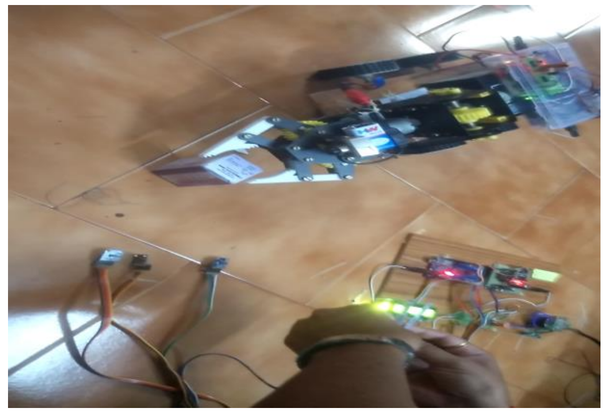
These systems can sense, control and activate mechanical processes on the micro scale and function individually or in arrays to generate effects on the macro scale. The micro fabrication technology enables fabrication of large arrays of devices, which individually perform simple tasks, but in combination can accomplish complicated functions. MEMS are not about any one application or device, or they are not defined by a single fabrication process or limited to a few materials. They are a fabrication approach that conveys the advantages of miniaturization, multiple components and microelectronics to the design and construction of integrated electromechanical systems.

The main program provides functions to retrieve and process the input image, convert it into a sound signal. Picture will be taken as soon as push button switch is pressed then this Captured image is thresholded before feeding it to OCR to increase the accuracy. Overall flow of program is done as in flowchart. The main challenge in myoelectric controlled interfaces lies in decoding neural signals to commands capable of operating the desired application. Many decoding algorithms have been developed using machine learning techniques, but these currently suffer from subject specificity and require intense training phases before any real-time application is feasible.

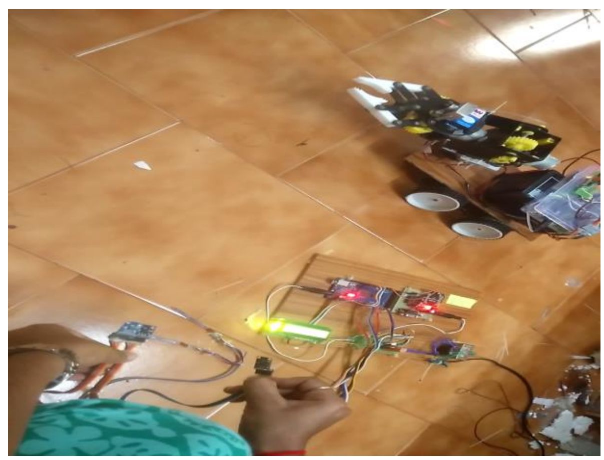
A few other approaches have implemented simple decoders meant to be intuitive for users to control simple commands, but these intuitive mappings suffer from task specificity and assume that intuitive commands translate to maximal performance for a given task. In both cases, the decoders are designed to maximize the initial performance of the user, which does not take advantage of a human’s natural ability to form inverse models of space , optimize control strategies and learn new muscle synergies while completing precise physical tasks. Thus, these approaches do not necessarily provide a foundation for maximal performance over time.

VI.RESULT

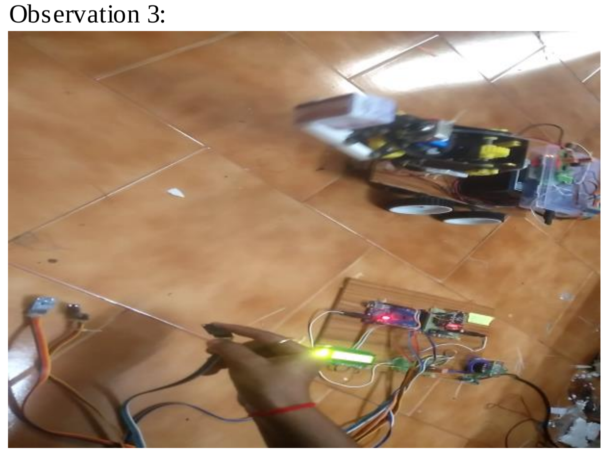
Observation 1:



Observation 2:



Observation 3:



VII.CONCLUSION

We proposed a fast and simple algorithm for hand gesture recognition for controlling robot. We have demonstrated the effectiveness of this computationally efficient algorithm on real images we have acquired. In our system of gesture controlled robots, we have only considered a limited number of gestures. Our algorithm can be extended in a number of ways to recognize a broader set of gestures. The gesture recognition portion of our algorithm is too simple, and would need to be improved if this technique would need to be used in challenging operating conditions. Reliable performance of hand gesture recognition techniques in a general setting require dealing with occlusions, temporal tracking for recognizing dynamic gestures, as well as 3D modeling of the hand, which are still mostly beyond the current state of the art. From above result it is conclude that microcontroller based motion control system is designed in such away that synchronization between hand motion and robot motion achieves at desired angles.

REFERENCES

[1] R. Weir, "Design of artificial arms and hands for prosthetic applications," In Standard Handbook of Biomedical Engineering & Design, Kutz, M.Ed. New York: McGraw-Hill, pp.32.1–32.61, 2003.

[2] D. Graupe, J. Magnussen and A.A.M. Beex, "A Microprocessor System for Multifunctional Control of Upper Limb Prostheses via Myoelectric Signal Identification," IEEE Transactions on Automatic Control, Vol.23, No.4, pp.538-544, 1978.

[3] S. Lee and G.N. Saridis, "The control of a prosthetic arm by EMG pattern recognition," IEEE Transactions on Automatic Control, Vol.29, No.4, pp.290-302, 1984.

[4] B. Hudgins, P.A. Parker and R.N. Scott, "A new strategy for multifunction myoelectric control," IEEE Transactions on Biomedical Engineering, Vol.40, No.1, pp.82-94, 1993.

[5] M.F. Kelly, P.A. Parker and R.N. Scott, "The Application of Neural Networks to Myoelectric Signal Analysis: A preliminary study," IEEE Transactions on Biomedical Engineering, Vol.37, No.3, pp.211-230, 1990.

[6] K. Ito, T. Tsuji, A. Kato and M. Ito, "An EMG Controlled Prosthetic Forearm in Three Degrees of Freedom Using Ultrasonic Motors," Proceedings of the Annual Conference the IEEE Engineering in Medicine and Biology Society, Vol.14, pp.1487-1488, 1992.