

MEMS based Robot to assist the Paralysed Patients

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Abstract— The design and implementation of this project is mainly based on human machine interface. This is a wireless gesture controlled system. In this project, we are designing a robot which moves according to the gestures. This gesture acts as the input signal for the robot with the help of MEMS sensors. Thus the movement of the robot is controlled by the MEMS sensors which are fixed in the fingers. The robot is equipped with wireless camera for capturing video and audio which is transmitted to the receiver connected to the personal computer. Those who operate this robot can view the robot surroundings in the personal computer.

Keywords—mems sensors; microcontroller unit; wireless camera; voice module.

I. INTRODUCTION

At present, humans are living with machines. Machines are now considered to be the essential part of human life. Hereafter humans may feel their life as discomfort without machines. This statement cannot be dissent by anyone. In recent years, there is a rapid increase in technology which leads to HUMAN MACHINE INTERFACE. In earlier stage, this interface was found to be more challenging. But the humans fought with the challenge and arrived in better solution called GESTURE. After the invention of gesture, the human machine interface was found to be very fluent. Gesture is a type of non-verbal communication. It includes the movement of hands, face, or other parts of the body. The improvement in technology leads to the construction of new industrialized society. This society also supplies some sort of problems for human life.

The main aim of this project is to design and construct the domesticated Robot: for assisting older adults and physically challenged. The user can wear this device to head and with the simple head movements he can control the robot and can send commands to robot, requesting some basic needs like water, food or medicine by using MEMS (Micro Electro-Mechanical Sensor) technology[1]. The requests will be announced by the robot which has the voice circuit and also Remote camera. The project also supports video camera mounted on to the robot of the live video transmission.

MEMS Accelerometer sensors are a Micro Electro Mechanical Sensor which is a highly sensitive and capable of detecting the tilt varies directions. This sensor finds the tilt and operates the robot and announces the basic needs depending on tilt. This device is very helpful for paralysed and physically challenged persons.

The main objectives of this project are:

1. Designing a Robot that assists the older age people.
2. Voice based announcement of needs.
3. Simple gesture based Robot controlling and need announcement.
4. RF wireless transmission of data.
5. Live video transmission.

II. GOAL OF CURRENT RESEARCH

In light of the SOC model [2], robots, as a compensatory technology, have potential to assist older adults to age in place. Successful integration of assistive robots into older adults' lives will require design of robots that meet their needs. It is not clear what tasks independent older adults would prefer a robot to assist with, the reasons why they hold such preferences, or their perceptions of robot assistance with maintaining their home. This understanding can inform the design of assistive robotics to support these tasks, and thereby aid older adults in aging-in-place. In this research study, we evaluated the potential of home robots to serve as a compensatory technology for older adults. Specifically, our research aimed to: Assess older adults' preference for assistance from robots or humans for home upkeep tasks (cleaning tasks, finding and fetching). Understand older adults' opinions of using a home robot. Consider the implications of findings for directing improvement efforts for the design of home assistive robots. Our needs assessment approach used a combination of questionnaire and structured group interview methodology to provide a rich set of quantitative and qualitative data.

III. RELATED WORK

Today, there are a number of robots used in robotics research, with many unique features and design criteria. In this section, brief of some recent and widely-used and/or Influential robots is given. In the robotics field, several research efforts have been directed towards recognizing human gestures. Few popular systems are:

3.1 Vision-based Gesture Recognition

This Recognition system basically worked in the field of Service Robotics [3] and the researchers finally designed a Robot performing the cleaning task. They designed a gesture-based interface to control a mobile robot equipped with a manipulator. The interface uses a camera to track a person and recognize gestures involving arm motion. A fast, adaptive tracking algorithm enables the robot to track and follow a person reliably through office environments with changing lighting conditions. Two gesture recognition methods i.e. a template based approach and a neural based approach were compared and combined with the Viterbi algorithm for the recognition of gestures defined through arm motion. It results in an interactive clean-up task, where the user guides the robot to go to the specific locations that need to be cleaned and also instructs the robot to pick up trash.

3.2 Motion Capture Sensor Recognition

This recognition technique made it possible to implement an accelerometer based system to communicate with an industrial robot wirelessly. [4] In this particular project the robot is powered with ARM7 based LPC1768 core. MEMS is a three

dimensional accelerometer sensor which captures gestures of human-arm and produces three different analog output voltages in three dimensional axes. And two flex sensors are used to control the robot movement.

3.3 Finger Gesture Recognition System based on Active Tracking Mechanisms

The prime aim of the system (based on the above mentioned recognition methodology) [5] proposed by the author is to make it feasible to interact with a portable device or a computer through the recognition of finger gestures. Apart from the gestures, speech can also be other mode of interaction because of which this system can form part of a so-called Perceptual User Interface (PUI). The system could be used for Virtual Reality or Augmented Reality systems.

3.4 Accelerometer-based Gesture Recognition

This Gesture Recognition methodology has become increasingly popular in a very short span of time. The low-moderate cost and relative small size of the accelerometers are the two factors that make it an effective tool to detect and recognize human body gestures.

Several studies have been conducted on the recognition of Gestures from acceleration data using Artificial Neural Networks (ANNs).

IV. DESIGN OF ROBOT USING MEMS

4.1 BLOCK DIAGRAM:

The hardware block diagram other than regulated power supply is as shown below

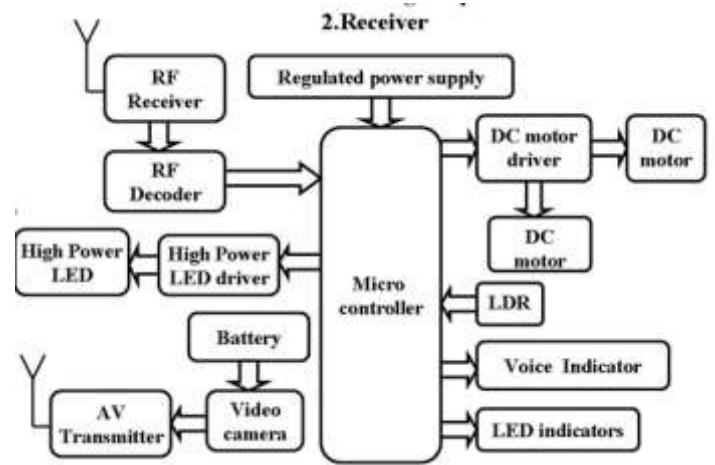


Fig 2 block diagram of receiver

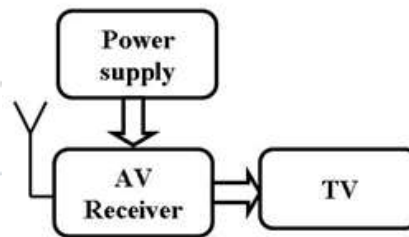


Fig 3 AV Receiver

The hardware essentially consists of the above components which are discussed in detail further.

4.1.1. PIC MICRO-CONTROLLER:-

The microcontroller used here is a 40 pin PIC microcontroller. The advantage of using this controller is that it can handle more than 3 sensors in parallel and also control them. PIC16F877A microcontroller is used which is of dual inline package. The features of this controller are very accurate and also advantageous when compared to other controllers. Due to this reason, this controller is preferred in this case.

4.1.2 MEMS SENSOR:

MEMS(Micro-electric-mechanical-system)-based accelerometers are devices that measure the proper acceleration. In relativity theory, proper acceleration is the physical acceleration experienced by the object. The physical acceleration is measurable by sensors. These sensors are part of the sensing cluster of ubiquitous technologies. Sensing technologies make use of physical parameters from the environment, such as temperature, pressure, force and light An accelerometer measures weight per unit of mass, a quantity also known as specific force, or g-force. Measuring g-forces allows users to for instance interact with products by means of gesture recognition.

4.1.3 ZIGBEE:

ZigBee is an IEEE 802.15.4-based specification for a suite of high-level communication protocols used to create personal area networks with small, low-power digital radios. The technology defined by the Zig-Bee specification is intended to be simpler and less expensive than other wireless personal area networks (WPANs), such as Bluetooth or Wi-Fi. Applications include wireless light switches, electrical meters

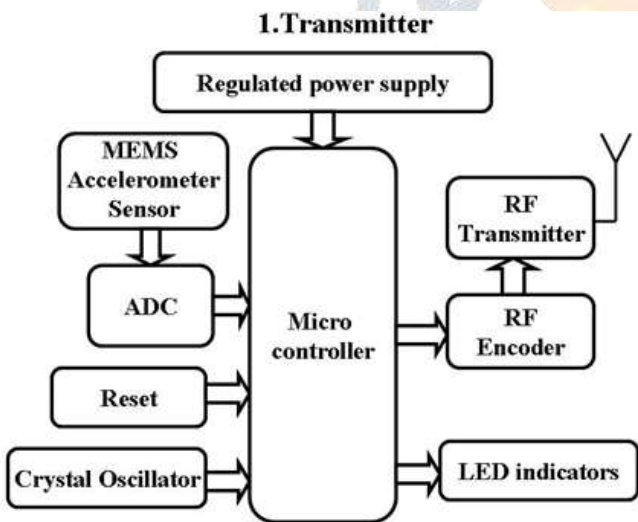


Fig 1 block diagram of transmitter

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

4.1.4 AV TRANSMITTER AND RECEIVER:

A audio/video sender is a device for transmitting domestic audio and video signals wirelessly from one location to another. It is most commonly used for sending the output of a source device, such as a satellite television decoder, to a television in another part of a property and provides an alternative to cable installations. An audio/video receiver (AVR) is a consumer electronics unit used in a home theater. Its primary purpose is to receive audio and video signals from a number of sources and process them to drive loudspeakers and a display. Possible displays include, television, monitor, or video projector while the inputs may come from, television, satellite receiver, radio, DVD players, Blue-ray Disc players, VCRs, and video game consoles. The AVR source signal and other settings, including volume, are normally set by a remote controller.

4.1.5 DC MOTORS:

A DC motor is any of a class of electrical machines that converts direct current electrical power into mechanical power. The most common types rely on the forces produced by magnetic fields. Nearly all types of DC motors have some internal mechanism, either electromechanical or electronic, to periodically change the direction of current flow in part of the motor. Most types produce rotary motion; a linear motor directly produces force and motion in a straight line.

4.1.6 WIRELESS CAMERA:

Wireless cameras are those that transmit a video and audio signal to a wireless receiver through a radio band. Many wireless cameras require at least one cable or wire for power; "wireless" refers to the transmission of video/audio. However, some wireless cameras are battery-powered, making the cameras truly wireless from top to bottom. Wireless cameras are proving very popular among modern security consumers due to their low installation costs (there is no need to run expensive video extension cables) and flexible mounting options.

V. SIMULATION AND ANALYSIS

Two softwares were used for coding and designing the circuit to check its performance.

PIC C Compiler and a Proteus 8 software are used.

PIC C Compiler: It is one among all the C compilers that provides best speed and code size for all pic controllers

The work to be done in pic compiler is to write the code and debug it.

Proteus 8: This software is responsible for designing the circuit by selecting and connecting the respective components. The code from pic c compiler is saved and then dumped in the circuit in proteus software and then is made to run. Here the

clock frequency of controller can be set by double clicking onto it. It can be checked after running the circuit whether there is a desired output or not.

The codes are written individually for each sensor for their respective functioning, integrated into a single code and then is dumped into the micro controller when it is coded perfectly i.e., when error free code is obtained. The results obtained are as shown below:

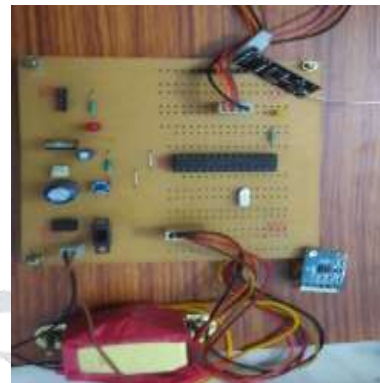


Fig: Result at the TRANSMITTER SIDE



Fig: Result at the RECEIVER SIDE

VI. CONCLUSION

This device is portable and this system operation is entirely driven by wireless technology. User can wear it to his head like a band and can operate it by tilting the MEMS Accelerometer sensor.

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