ISSN No: 2348-4845
International Journal & Magazine of Engineering, Technology, Management and Research
A Peer Reviewed Open Access International Journal

Active In-Hand Object Detection on Robot Using MEMS

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Abstract:

This paper presents the development of robot that can be commanded by the user in a supervised way. Our robot is designed to detect an object with MEMS, IR sensors, RF module, ARM7 processor, LCD, DC motors and battery. This system is used to detect an object while a disabled person is moving one place to another. If there is any object detected displayed on the LCD and also the direction where the person is moving either front, back, left or right. This system is designed for safety purpose of the disabled persons like blind, Dum and deaf.

I.INTRODUCTION:

According to a new report prepared jointly by the World Health Organization and the World Bank, 15 percent of the world's population is disabled. The use of powered wheelchairs with high navigational intelligence is one of the great steps towards the integration of severely physically disabled and mentally handicapped people. Simultaneously blind and paraplegic people deal with two problems, which creates uneasy situation for them, i.e. locomotion and localization. Our robot is designed to detect an object.

The system is designed with MEMS, IR sensors, RF module, ARM7 processor, LCD, battery and DC motors. This system is used to detect an object while a disabled person is moving one place to another. If there is any object detected displayed on the LCD and also the direction where the person is moving either front, back, left or right. This system is designed for safety purpose of the disabled persons like blind, Dum and deaf.

II.COMPONENTS USED:

The hardware and software components used are as follows:

Hardware requirement:

- ARM7TDMI-S microcontroller in a tiny LQFP64 package. It is a 16 bit/32 bit controller. 8kB to 40kB of on-chip static RAM and 32kB to 512kB of on-chip flash memory.
- One or two (LPC2141/42 vs. LPC2144/46/48) 10-bit ADCs provide a total of 6/14 analog inputs, with conversion times as low as 2.44µs per channel.
- Single 10-bit DAC provides variable analog output (LPC2142/44/46/48 only).
- Two 32-bit timers/external event counters (with four capture and four compare channels each), PWM unit (six outputs) and watchdog. LPC2148 each contains two UARTs.
- Low power Real-Time Clock (RTC) with independent power and 32 kHz clock input.
- Micro electromechanical systems (MEMS) are small integrated devices or systems that combine electrical and mechanical components. MEMS are not about any one application or device, nor are they defined by a single fabrication process or limited to a few materials.
- Motor is a device that creates motion, not an engine; it usually refers to either an electrical motor or an internal combustion engine. DC motor, an electric motor that runs on direct current electricity. A dc motor is used for the movement of the robot.

Software requirement:

- KEIL: It is a compiler tool provides the platform for writing, execution and compiles the program. The program used in the project is embedded 'c'. It generates .hex file which burn on to chip.
- Embedded C which is an easy language to design the program code.
- Proteus is used to design the circuit.
- Flash magic is used to dump the code to processor.

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III.CONTENT DIAGRAM OF THE PROJECT

Receiver section:

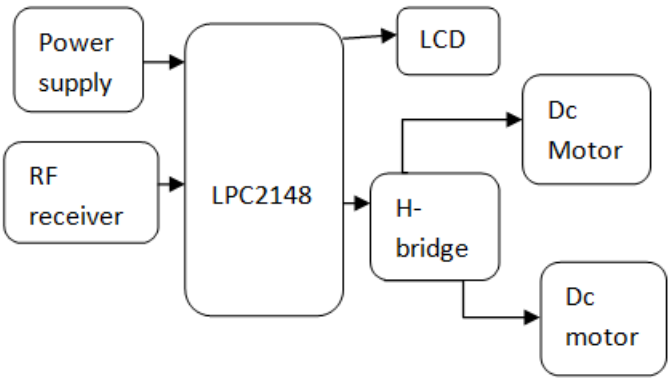

Figure1: Block diagram of receiver.

Transmitter section:

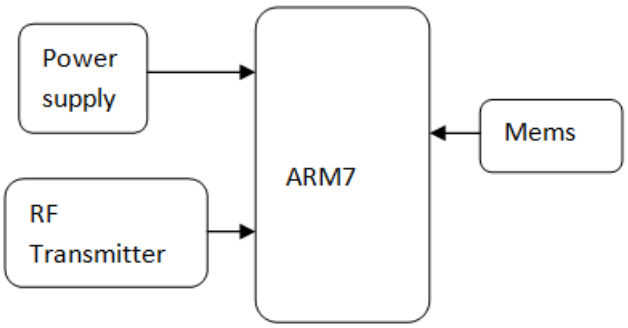

Figure2: Block diagram of transmitter.

IV.LITERATURE SURVEY:

According to a new report prepared jointly by the World Health Organization and the World Bank, 15 percent of the world's population is disabled. The use of powered wheelchairs with high navigational intelligence is one of the great steps towards the integration of severely physically disabled and mentally handicapped people. Driving a wheelchair is a tedious task for severely handicapped persons, unless they use the tongue to control the joystick.

Simultaneously blind and paraplegic people deal with two problems, which creates uneasy situation for them, i.e. locomotion and localization. Different systems are being developed to overcome the problems described above, allowing the end user to perform safe movements and accomplish some daily life important tasks

Existing system:

There is no other system before this. Here in this paper by using gesture automatically we can controls the robot. In proposed systems we are implementing in advance by MEMS technology and IR sensors automatically robot can be guided so.

Proposed system:

Here in proposed systems we are implementing in advance by MEMS technology and IR sensors automatically robot can be guided so. This system is used to detect an object while a disabled person is moving one place to another.The system is designed with MEMS, IR sensors, RF module, ARM7 processor, LCD and DC motors. . This system is designed for safety purpose of the disabled persons like blind, Dum and deaf

V.ARM 7 PROCESSOR

A silicon chip that contains a CPU. In the world of personal computers, the terms microprocessor and CPU are used interchangeably. At the heart of all personal computers and most workstations sits a microprocessor. Microprocessors also control the logic of almost all digital devices, from clock radios to fuel-injection systems for automobiles.

Three basic characteristics differentiate microprocessors:

» Instruction set: The set of instructions that the microprocessor can execute.
» Bandwidth : The number of bits processed in a single instruction.
» Clock speed : Given in megahertz (MHz), the clock speed determines how many instructions per second the processor can execute.

A microprocessor has three basic elements, as shown above. The ALU performs all arithmetic computations, such as addition, subtraction and logic operations (AND, OR, etc). It is controlled by the Control Unit and receives its data from the Register Array. The Register Array is a set of registers used for storing data. These registers can be accessed by the ALU very quickly. Some registers have specific functions - we will deal with these later.

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The Control Unit controls the entire process. It provides the timing and a control signal for getting data into and out of the registers and the ALU and it synchronizes the execution of instructions (we will deal with instruction execution at a later date).

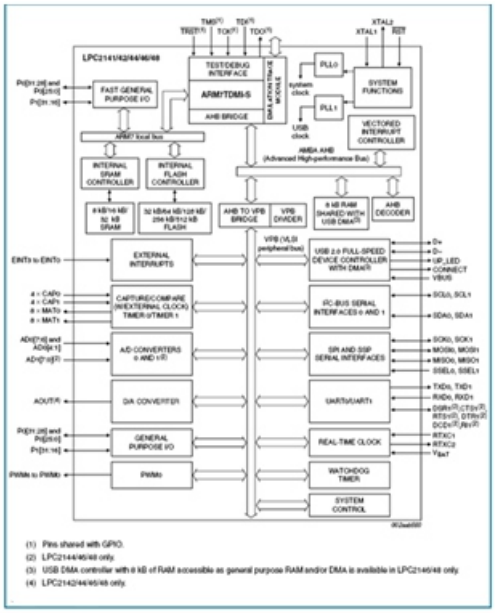

Figure3: Block diagram of arm

TheLPC2141/42/44/46/48 microcontrollers are based on a 16-bit/32-bit ARM7TDMI-S CPU with real-time emulation and embedded trace support, that combine microcontroller with embedded high speed flash memory ranging from 32 kB to 512 kB. A 128-bit wide memory interface and a unique accelerator architecture enable 32-bit code execution at the maximum clock rate. For critical code size applications, the alternative 16-bit Thumb mode reduces code by more than 30 % with minimal performance penalty. Due to their tiny size and low power consumption, LPC2141/42/44/46/48 are ideal for applications where miniaturization is a key requirement, such as access control and point-of-sale.

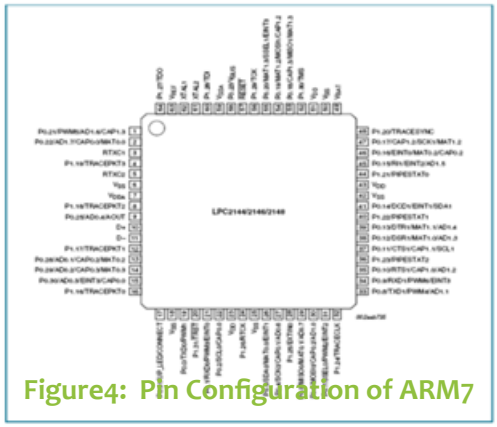

Figure4: Pin Configuration of ARM7

VI.MICROELECTROMECHANICAL SYSTEMS (MEMS):

Micro electromechanical systems (MEMS) are small integrated devices or systems that combine electrical and mechanical components. They range in size 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.

Applications of MEMS:

A. Pressure Sensors: MEMS pressure micro sensors typically have a flexible diaphragm that deforms in the presence of a pressure difference. A pressure sensor can be used to sense the absolute air pressure within the intake manifold of an automobile engine, so that the amount of fuel required for each engine cylinder can be computed.

B. Accelerometers:

Accelerometers are acceleration sensors. An inertial mass suspended by springs is acted upon by acceleration forces that cause the mass to be deflected from its initial position. This deflection is converted to an electrical signal, which appears at the sensor output. The application of MEMS technology to accelerometers is a relatively new development.

C. Inertial Sensors:

Inertial sensors are a type of accelerometer and are one of the principal commercial products that utilize surface micromachining. They are used as airbag-deployment sensors in automobiles, and as tilt or shock sensors. The application of these accelerometers to inertial measurement units (IMUs) is limited by the need to manually align and assemble them into three-axis systems, and by the resulting alignment tolerances, their lack of in-chip analog-to-digital conversion circuitry, and their lower limit of sensitivity.

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D. Microengines: A three-level polysilicon micromachining process has enabled the fabrication of devices with increased degrees of complexity. The process includes three movable levels of polysilicon, each separated by a sacrificial oxide layer, plus a stationary level. Operation of the small gears at rotational speeds greater than 300,000 rpm has been demonstrated. Microengines can be used to drive the wheels of microcombination locks. They can also be used in combination with a microtransmission to drive a pop-up mirror out of a plane. This device is known as a micromirror.

What is MEMS Technology?

Micro-Electro-Mechanical Systems, or MEMS, is a technology that in its most general form can be defined as miniaturized mechanical and electro-mechanical elements (i.e., devices and structures) that are made using the techniques of microfabrication. The critical physical dimensions of MEMS devices can vary from well below one micron on the lower end of the dimensional spectrum, all the way to several millimeters. Likewise, the types of MEMS devices can vary from relatively simple structures having no moving elements, to extremely complex electromechanical systems with multiple moving elements under the control of integrated microelectronics. The one main criterion of MEMS is that there are at least some elements having some sort of mechanical functionality whether or not these elements can move. The term used to define MEMS varies in different parts of the world. In the United States they are predominantly called MEMS, while in some other parts of the world they are called "Microsystems Technology" or "micromachined devices".

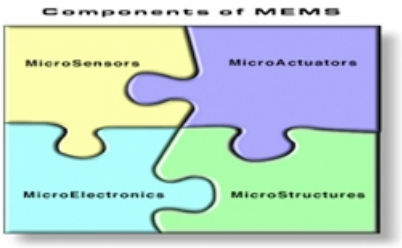

Figure5: Components of MEMS

VII. DC MOTOR:

Motor is a device that creates motion, not an engine; it usually refers to either an electrical motor or an internal combustion engine. DC motor, an electric motor that runs on direct current electricity

• Brushed DC electric motor, an internally commutated electric motor designed to be run from a direct current power source

• Brushless DC motor, a synchronous electric motor which is powered by direct current electricity and has an electronically controlled commutation system, instead of a mechanical commutation system based on brushes

The brushed DC motor is one of the earliest motor designs. Today, it is the motor of choice in the majority of variable speed and torque control applications.

Working of a DC motor:

In any electric motor, operation is based on simple electromagnetism. A current-carrying conductor generates a magnetic field; when this is then placed in an external magnetic field, it will experience a force proportional to the current in the conductor, and to the strength of the external magnetic field. As you are well aware of from playing with magnets as a kid, opposite (North and South) polarities attract, while like polarities (North and North, South and South) repel. The internal configuration of a DC motor is designed to harness the magnetic interaction between a current-carrying conductor and an external magnetic field to generate rotational motion.

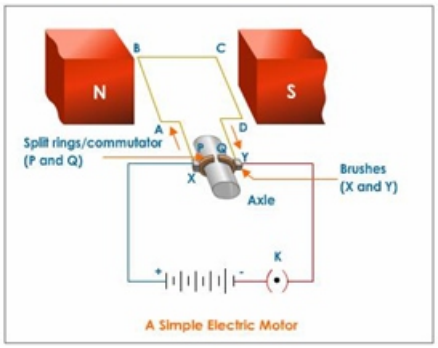

Figure6: Working of a DC Motor

Parts of a DC Motor:

Armature: A D.C. motor consists of a rectangular coil made of insulated copper wire wound on a soft iron core. This coil wound on the soft iron core forms the armature. The coil is mounted on an axle and is placed between the cylindrical concave poles of a magnet.

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Commutator:

A commutator is used to reverse the direction of flow of current. Commutator is a copper ring split into two parts C1 and C2. The split rings are insulated from each other and mounted on the axle of the motor. The two ends of the coil are soldered to these rings. They rotate along with the coil. Commutator rings are connected to a battery. The wires from the battery are not connected to the rings but to the brushes which are in contact with the rings.

Brushes:

Two small strips of carbon, known as brushes press slightly against the two split rings, and the split rings rotate between the brushes.The carbon brushes are connected to a D.C. source.

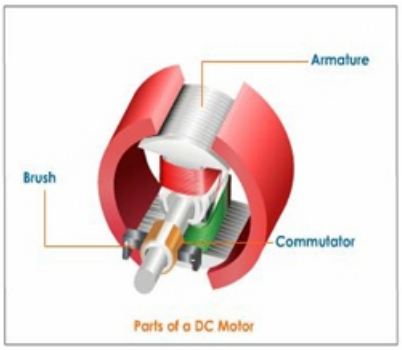

Figure7: Parts of DC motor

VIII.LCD:

LCD stands for Liquid Crystal Display. LCD is finding wide spread use replacing LEDs (seven segment LEDs or other multi segment LEDs) because of the following reasons:

1.The declining prices of LCDs.

2.The ability to display numbers, characters and graphics. This is in contrast to LEDs, which are limited to numbers and a few characters.

3.Incorporation of a refreshing controller into the LCD, thereby relieving the CPU of the task of refreshing the LCD. In contrast, the LED must be refreshed by the CPU to keep displaying the data.

4.Ease of programming for characters and graphics.

5.These components are "specialized" for being used with the microcontrollers, which means that they cannot be activated by standard IC circuits. They are used for writing different messages on a miniature LCD.

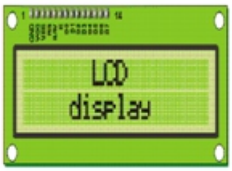

Figure8: LCD display

A model described here is for its low price and great possibilities most frequently used in practice. It is based on the HD44780 microcontroller (Hitachi) and can display messages in two lines with 16 characters each. It displays all the alphabets, Greek letters, punctuation marks, mathematical symbols etc. In addition, it is possible to display symbols that user makes up on its own. Automatic shifting message on display (shift left and right), appearance of the pointer, backlight etc. are considered as useful characteristics.In this system the LCD is used to display the direction of the user and also display that the object is detected.

IX.RF MODULE (TRANSMITTER AND RECEIVED):

The RF module, as the name suggests, operates at Radio Frequency. The corresponding frequency range varies between 30 kHz & 300 GHz. In this RF system, the digital data is represented as variations in the amplitude of carrier wave. This kind of modulation is known as Amplitude Shift Keying (ASK).

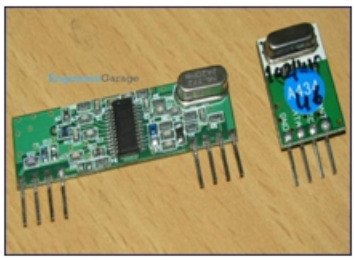

Figure9: RF module

Transmission through RF is better than IR (infrared) because of many reasons. Firstly, signals through RF can travel through larger distances making it suitable for long range applications.

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Also, while IR mostly operates in line-of-sight mode, RF signals can travel even when there is an obstruction between transmitter & receiver. Next, RF transmission is more strong and reliable than IR transmission. RF communication uses a specific frequency unlike IR signals which are affected by other IR emitting sources. This RF module comprises of an RF Transmitter and an RF Receiver. The transmitter/receiver (Tx/Rx) pair operates at a frequency of 434 MHz An RF transmitter receives serial data and transmits it wirelessly through RF through its antenna connected at pin4. The transmission occurs at the rate of 1Kbps - 10Kbps.The transmitted data is received by an RF receiver operating at the same frequency as that of the transmitter. The RF module is often used alongwith a pair of encoder/decoder. The encoder is used for encoding parallel data for transmission feed while reception is decoded by a decoder.HT12E-HT12D, HT640-HT648, etc. are some commonly used encoder/decoder pair ICs.

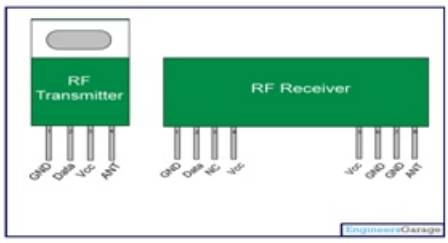

Figure10: Pin Diagram

Types of RF modules:

The term RF module can be applied to many different types, shapes and sizes of small electronic sub assembly circuit board. It can also be applied to modules across a huge variation of functionality and capability. RF modules typically incorporate a printed circuit board, transmit or receive circuit, antenna, and serial interface for communication to the host processor.Most standard, well known types are covered here:

- Transmitter module
- Receiver module
- Transceiver module
- System on a chip module

X.IR SENSOR:

Infrared (IR) is invisible radiant energy, electromagnetic radiation with longer wavelengths than those of visible light, extending from the nominal red edge of the visible spectrum at 700 nanometers (frequency 430 THz) to 1 mm (300 GHz) (although people can see infrared up to at least 1050 nm in experiments[2][3][4][5]). Most of the thermal radiation emitted by objects near room temperature is infrared.Infrared radiation was discovered in 1800 by astronomer Sir William Herschel, who discovered a type of invisible radiation in the spectrum lower in energy than red light, by means of its effect upon a thermometer.[6] Slightly more than half of the total energy from the Sun was eventually found to arrive on Earth in the form of infrared. The balance between absorbed and emitted infrared radiation has a critical effect on Earth's climate.Infrared radiation extends from the nominal red edge of the visible spectrum at 700 nanometers (nm) to 1 mm. This range of wavelengths corresponds to a frequency range of approximately 430 THz down to 300 GHz. Below infrared is the microwave portion of the electromagnetic spectrum.

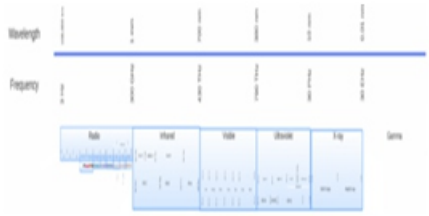

Figure11: Infrared in relation to electromagnetic spectrum

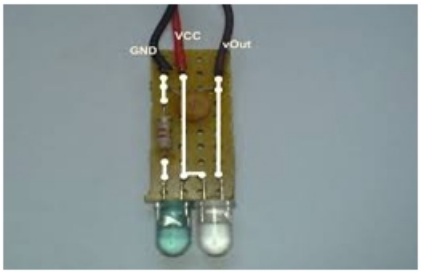

Figure12: IR sensor

Here two IR sensors are used detect the object which is placed in front or back of the system.

XI.BATTERY:

If voltage supply unit cannot meet this condition or if it is needed to provide completely safe operating, the process of initialization by which a new reset enabling display to operate normally must be applied. A battery is like a piggy bank.

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If you keep taking out and putting nothing back you soon will have nothing. Present day chassis battery power requirements are huge. Consider today's vehicle and all the electrical devices that must be supplied. All these electronics require a source of reliable power, and poor battery condition can cause expensive electronic component failure.

It was not long ago when trailers or motor homes had only a single 12-volt house battery. Average battery life has become shorter as energy requirements have increased. Life span depends on usage; 6 months to 48 months, yet only 30% of all batteries actually reach the 48-month mark. You can extend your battery life by hooking it up to a solar charger during the off months.

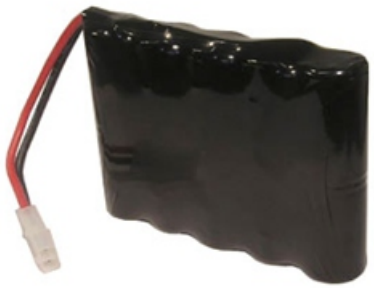

Figure13 :12v battery

The Lead Acid battery is made up of plates, lead, and lead oxide (various other elements are used to change density, hardness, porosity, etc.) with a 35% sulfuric acid and 65% water solution. This solution is called electrolyte, which causes a chemical reaction that produce electrons.

When you test a battery with a hydrometer, you are measuring the amount of sulfuric acid in the electrolyte. If your reading is low, that means the chemistry that makes electrons is lacking. So where did the sulfur go? It is resting on the battery plates and when you recharge the battery, the sulfur returns to the electrolyte.

XII.INTERFACING STRUCTURE:

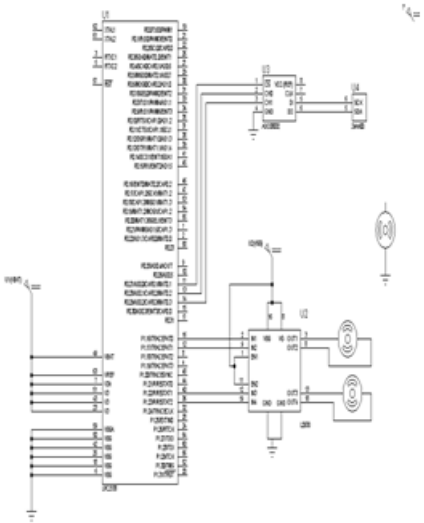

Figure14: interfacing diagram.

XIII.RESULT ANALYSIS

The following figure shows the kit arrangement of System module.

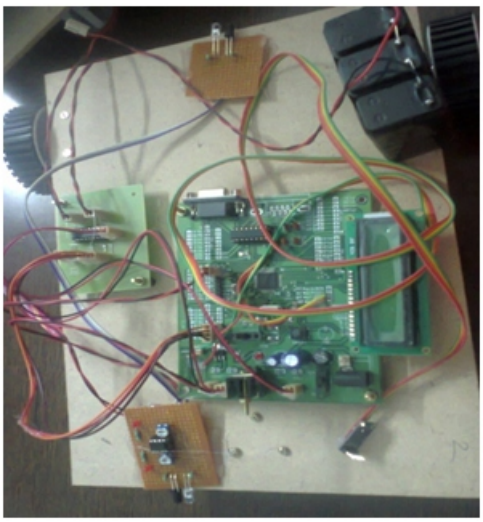

Figure15: kit arrangement of system module

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XIV.CONCLUSION:

According to a new report prepared jointly by the World Health Organization and the World Bank, 15 percent of the world's population is disabled. The use of powered wheelchairs with high navigational intelligence is one of the great steps towards the integration of severely physically disabled and mentally handicapped people. Driving a wheelchair is a tedious task for severely handicapped persons, unless they use the tongue to control the joystick. Simultaneously blind and paraplegic people deal with two problems, which creates uneasy situation for them, i.e. locomotion and localization. Different systems are being developed to overcome the problems described above, allowing the end user to perform safe movements and accomplish some daily life important tasks.

Our robot is designed to detect an object. The system is designed with MEMS, IR sensors, RF module, ARM7 processor, LCD and DC motors. This system is used to detect an object while a disabled person is moving one place to another. If there is any object detected in the path where the user is moving then the robot gives a beep sound and displays that some object is detected. By this the user can move in another direction so that the user can avoid the accident that may occur. The direction of the user is displayed on the LCD whether the person is moving either front, back, left or right. This system is designed for safety purpose of the disabled persons like blind, Dum and deaf.

XV.FUTURESCOPE:

This can be further developed by using a voice process and image recognization scheme instead of using MEMS and RF module. The future development can be done in a way that all type of disabled can use this system. The system is designed with MEMS, IR sensors, RF module, ARM7 processor, LCD and DC motors. This system is used to detect an object while a disabled person is moving one place to another. This system is designed for safety purpose of the disabled persons like blind, Dum and deaf.

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