ACCELEROMETER BASED HAND GESTURE CONTROLLED WHEELCHAIR

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Abstract— **Wheelchairs are used by the people who cannot walk due to physiological or physical illness, old age, injury or any disability. Recent development promises a wide scope in developing smart wheelchairs. The present article presents a gesture based wheelchair which controls the wheelchair using hand movement. The system is divided into two main units: The MEMS sensor and wheelchair control. The MEMS sensor, which is connected to hand, is an 3 axis accelerometer with digital output (12C) that provides hand gesture detection, converts it into the 6 bit digital values. Due to dependence on others, a person loses their confidence and desire to live their life independently. With the help of this wheelchair they become able to be a bit independent. This research paper introduces the design and implementation of a novel hands free control system for intelligent wheel chair.**

Index terms- **wheelchairs, accelerometer, implementation, intelligent wheel chair.**

I. INTRODUCTION

The proposed system comprises of two main parts Transmitter part and receiver part. In transmitter part the hand gesture is recognized by the sensor, digital output is transmitted to the controller and then transmitted to receiver side by the rf transmitter. The same data is received at receiver side by the rf receiver. 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.

II. RELATED WORK

Author [1] Proposed a wheelchair user centered design an anthropometric study is performed in the province of Tungurahua, Ecuador. The study group consists of 22 people who are wheelchairs users, are capable to perform professional activities with their upper limbs, have acquired the disability after reaching their physical maturity and are in working-age. A Kano´s refined model questionnaire was applied to categorize criteria related to wheelchairs design parameters into different types of qualities to determine the user's preferences. In order to determinate the wheelchair dimensions, a chart with 13 chosen body measurements were developed.

Author [2] Represented hardware implementation of controlling a robotic vehicle wirelessly with the help of hand gestures. Accelerometer based hand gesture control system depends on the hand movement of the user. For different types of hand movement the Robot works in different directions. A robot which can be controlled wirelessly with the help of hand gesture is much easier than other controlling methods. The gesture control system gives a new dimension in the world of controller. The focus of the project was to sense the hand gesture wirelessly. Different types of gesture can give the different value to the sensor, so by observing various data of sensor for hand gesture we tried to implement it on a gesture sensing wireless robot.

III. PROPOSED SYSTEM

In addition to the existing system wheelchair is operated using hand gesture by the person who is sitting in the wheelchair. To sense the hand gesture of the person, MEMS accelerometer is being used.

IV. BLOCK DIAGRAM

The below diagram shows the block diagram of Accelerometer based Hand Gesture controlled Wheelchair Transmitter and receiver section.
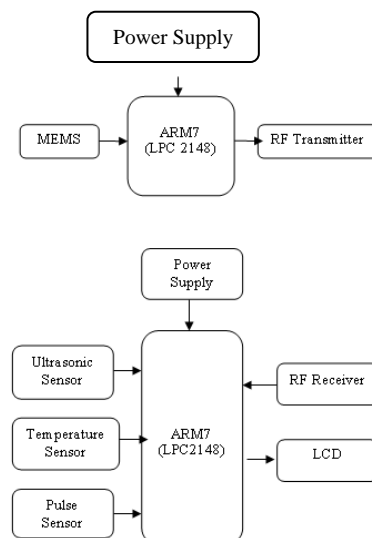
V. ARM7(LPC2148)

Using the ARMv7 architecture, ARM can strengthen its position as a low-power/performance leader while conquering new markets to carry its cores up in high performance and down in the low-cost high-volume domain of the microcontroller ARM designs the technology that lies at the heart of advanced digital products, from wireless, networking and consumer entertainment solutions to imaging, automotive, security and storage devices. ARM's comprehensive product offering includes 16/32-bit RISC microprocessors, data engines, 3D processors, digital libraries, embedded memories, peripherals, software and development tools, as well as analog functions and high-speed connectivity products.

VI. MEMS

MEMS accelerometers are one of the simplest but also most applicable micro-electromechanical systems. They became indispensable in automobile industry, computer and audio-video technology. This seminar presents MEMS technology as a highly developing industry. Special attention is given to the capacitor accelerometers, how do they work and their applications. The seminar closes with quite extensively described MEMS fabrication. An accelerometer is an electromechanical device that measures acceleration forces. These forces may be static, like the constant force of gravity pulling at our feet, or they could be dynamic - caused by moving or vibrating the accelerometer. There are many types of accelerometers developed and reported in the literature. The vast majority is based on piezoelectric crystals, but they are too big and too clumsy. People tried to develop something smaller, that could increase applicability and started searching in the field of microelectronics. They developed MEMS (micro electromechanical systems) accelerometers. The first micro machined accelerometer was designed in 1979 at Stanford University, but it took over 15 years before such devices became accepted mainstream products for large volume applications. In the 1990s MEMS accelerometers revolutionized the automotive-airbag system industry. Since then they have enabled unique features and applications ranging from hard-disk protection on laptops to game controllers. More recently, the same sensor-core technology has become available in fully integrated, full-featured devices suitable for industrial applications. Micro machined accelerometers are a highly enabling technology with a huge commercial potential. They provide lower power, compact and robust sensing. Multiple sensors are often combined to provide multi-axis sensing and more accurate data.

Micro Electro Mechanical Systems or MEMS is a term coined around 1989 by Prof. R. Howe and others to describe an emerging research field, where mechanical elements, like cantilevers or membranes, had been manufactured at a scale more akin to microelectronics circuit than to lathe machining. It appears that these devices share the presence of features below 100m that are not machined using standard machining but using other techniques globally called micro-fabrication technology. Of course, this simple definition would also include microelectronics, but there is a characteristic that electronic circuits do not share with MEMS. While electronic circuits are inherently solid and compact structures, MEMS have holes, cavity, channels, cantilevers, membranes, etc, and, in some way, imitate 'mechanical' parts.

The emphasis on MEMS based on silicon is clearly a result of the vast knowledge on silicon material and on silicon based micro fabrication gained by decades of research in microelectronics. And again, even when MEMS are based on silicon, microelectronics process needs to be adapted to cater for thicker layer deposition, deeper etching and to introduce special steps to free the mechanical structures. MEMS needs a completely different set of mind, where next to electronics, mechanical and material knowledge plays a fundamental role. Then, many more MEMS are not based on silicon and can be manufactured in polymer, in glass, in quartz or even in metals. The development of a MEMS component has a cost that should not be misevaluated and the technology has the possibility to bring unique benefit. The reasons that prompt the use of MEMS technology are for example miniaturization of existing devices, development of new devices based on principles that do not work at larger scale, development of new tools to interact with the micro-world. Miniaturization reduces cost by decreasing material consumption. It also increases applicability by reducing mass and size allowing to the MEMS in places where a traditional system doesn't fit. A typical example is brought by the accelerometer developed as a replacement for traditional airbag triggering sensor also used in digital cameras to help stabilize the image or even in the contact-less game controller integrated in the latest hand phones. Another advantage that MEMS can bring relates with the system integration. Instead of having a series of external components (sensor, inductor) connected by wire or soldered to a printed circuit board, the MEMS on silicon can be integrated directly with the electronics. These so called smart integrated MEMS already include data acquisition, filtering, data storage, communication, interfacing and networking. As we see, MEMS technology not only makes the things smaller but often makes them better.

There are many different ways to make an accelerometer. Some accelerometers use the piezoelectric effect - they contain microscopic crystal structures that get stressed by accelerative forces, which cause a voltage to be generated. Another way to do it is by sensing changes in capacitance. This seminar is focused on the latter. Capacitive interfaces have several attractive features. In most micromachining technologies no or minimal additional processing is needed. Capacitors can operate both as sensors and actuators. They have excellent sensitivity and the transduction mechanism is intrinsically insensitive to temperature. Capacitive sensing is independent of the base material and relies on the variation of capacitance when the geometry of a capacitor is changing. Neglecting the fringing effect near the edges, the parallel-plate capacitance is where A = 0A and A is the area of the electrodes, d the distance between them and the permittivity of the material separating them. A change in any of these parameters will be measured as a change of capacitance and variation of each of the three variables has been used in MEM sensing. For example, whereas chemical or humidity sensor may be based on a change of, accelerometers have been based on a change in d or in A. If the dielectric in the capacitor is air, capacitive

sensing is essentially independent of temperature but contrary to piezo resistivity, capacitive sensing requires complex readout electronics. Still the sensitivity of the method can be very large and, for example, Analog Device used for his range of accelerometer a comb capacitor having a suspended electrode with varying gap. Measurement showed that the integrated electronic circuit could resolve a change of the gap distance of only 20pm, a mere 1=5th of the silicon inter-atomic distance. Typical MEMS accelerometer is composed of movable proof mass with plates that is attached through a mechanical suspension system to a reference frame.

VII. KEIL C COMPILER

Keil Software publishes one of the most complete development tool suites for 8051 software, which is used throughout industry. For development of C code, their Developer's Kit product includes their C51 compiler, as well as an integrated 8051 simulator for debugging. A demonstration version of this product is available on their website, but it includes several limitations.

The C programming language was designed for computers, though, and not embedded systems. It does not support direct access to registers, nor does it allow for the reading and setting of single bits, two very important requirements for 8051 software. In addition, most software developers are accustomed to writing programs that will be executed by an operating system, which provides system calls the program may use to access the hardware. However, much code for the 8051 is written for direct use on the processor, without an operating system. To support this, the Keil compiler has added several extensions to the C language to replace what might have normally been implemented in a system call, such as the connecting of interrupt handlers.

In writing applications for a typical computer, the operating system handles manages memory on behalf of the programs, eliminating their need to know about the memory structure of the hardware. Even more important, most computers having a unified memory space, with the code and data sharing the same RAM. This is not true with the 8051, which has separate memory spaces for code, on-chip data, and external data.

VIII. ORCAD CAPTURE CIS

OrCAD Capture CIS is designed to reduce production delays and cost overruns through efficient management of components. It reduces the time spent searching existing parts for reuse, manually entering part information content, and maintaining component data. Users search parts based on their electrical characteristics and OrCAD Capture CIS automatically retrieves the associated part. Flexible and scalable, the solution is quickly implemented. OrCad Capture CIS is ideal for individual design teams or multi-site teams who need to collaborate across multiple locations. It provides access to cost information so designers can use preferred, lower cost, and instock parts. The embedded part selector accesses information stored in MRP/ERP systems and engineering databases and synchronizes externally sourced data with the schematic design database, so bills of materials can be automatically generated.

IX. RF MODULE

Any frequency within the electromagnetic spectrum associated with radio wave propagation. When an RF current is supplied to an antenna, an electromagnetic field is created that then is able to propagate through space. Many wireless technologies are based on RF field propagation. The 10 kHz to 300 GHz frequency range that can be used for wireless communication used generally to refer to the radio signal generated by the system transmitter, or to energy present from other sources that may be picked up by a wireless receiver. The TWS-434 extremely small, and are excellent for applications requiring short-range RF remote controls. The transmitter module is only 1/3 the size of a standard postage stamp, and can easily be placed inside a small plastic enclosure. The transmitter output is up to 8mW at 433.92MHz with a range of approximately 400 foot (open area) outdoors. Indoors, the range is approximately 200 foot, and will go through most walls. The receiver also operates at 433.92MHz, and has a sensitivity of 3uV. The WS-434 receiver operates from 4.5 to 5.5 volts-DC, and has both linear and digital outputs. Transmitting And Receiving. Full duplex or simultaneous two-way operation is not possible with these modules. If transmit and receive module are in close proximity and data is sent to a remote receive module while attempting to simultaneously receive data from a remote transmit module, the receiver will be overloaded by its close proximity transmitter. This will happen even if encoders and decoders are used with different address settings for each transmitter and receiver pair. If two way communications is required, only half duplex operation is allowed.

X. SIMULATION RESULTS
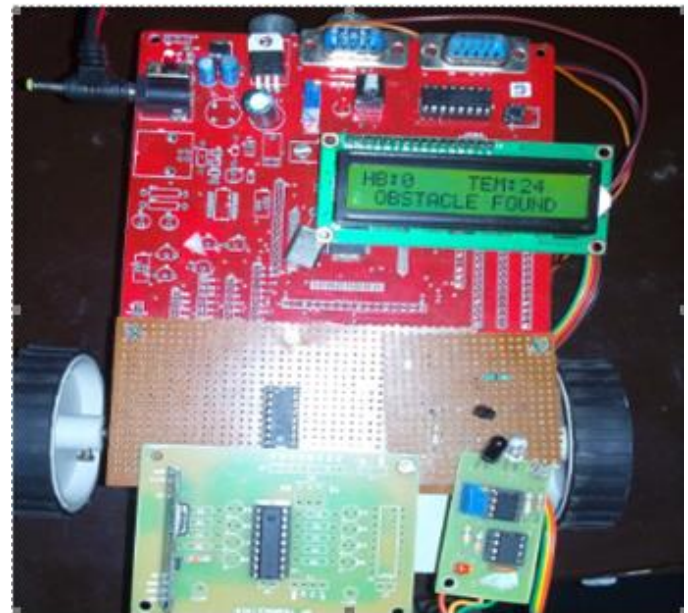
CONCLUSION AND FUTURE WORK

In the race of man versus machine, hand gesture controlled systemm comes as an e.g. of companionship of man and machine. Taking the technology to the next level from speech recognitions and wired connections is the technology of wireless hand gesture controlled system. Using a simple I2C chip we can connect up to 128 chairs using a single remote. The applications of the same can be plenty. This system gives the user independence and a psychological advantage of being independent. To avoid physical hardship to the user come the accelerometer to the rescue as with the slight twist of the finger the user gets the ability and freedom to turn the wheelchair into the desired direction. Of course some training is essential to use the accelerometer as its quite sensitive.But in the end there could not be a better use of technology for an individual who is deprived of the same physical strength. Our paper is capable to control the wheelchair motion fordisabled people using hand gesture. Improvements can be made by using various body gestures such as eye gaze, leg movement or head movement accordingly. The system proves a very competitive performance computationally and in terms of recognition accuracy. Interesting topic to research is the problem of tilting. As mentioned earlier, tilting of the remote can lead to erroneous recognition if not taken into account. Therefore, in our proposed system, subjects were requested to hold the remote in a natural way while performing the gestures and to avoid any tilting of the remote as much as possible. However, this way of holding the remote can result in some inconvenience to users of the system. Consequently, a system which is immune to tilting of the accelerometer is definitely a desirable one.

In future several wheelchairs (up to 128) can be operated using a single remote with accelerometer and PIC as master and various wheelchairs developed using microcontrollers as slave. This system can be extended by including GSM which sends an SMS during emergency by assigning particular gesture command. By including GPS, position of the wheelchair can also be known. Wheel chair can be fitted with direct mind reader. For example, if a person is paralyzed and cannot move his body parts, in that case it can be used. Voice monitoring helps the disabled person to determine the obstacle by acknowledging with alarm signals with slight modification in power section by monitoring the battery voltage levels. This enhances the speed and estimate the delay for action to be taken.to enhance the speed of the wheelchair dc motors can be replaced by servomotors.

When testing the MCU program with the hardware, we noticed that the receiver would instantly register a pong whenever the button was pushed to send the ping. As a result, distances of insanely small values were being reported. It ended up being a hardware problem when we wired the two transducers. The feed lines to the transducers were very close physically and it ended up that they were interfering with each other. This problem was not initially noticed when testing with the signal generator. This improved the interference issue and we were no longer seeing spikes on the receiver at the same time as the transmitted ping.Even though we were able to get rid of some of the noise by rerouting some of the wires on the board, we still had some inexplicable noise. We had thought that if we increased the gain of the signal from the receiving transducer and fed it through multiple Schmitt triggers to clean up the signal, we would be better off. Unfortunately, the gain also increased the amplitude of the noise to the point where it was giving us erroneous measurements. Since we were using a variable power supply as the power source of our board during testing, we noticed that if we decreased the supply voltage from 18 volts down to 9 volts, the noise was reduced. It so happened that the extra gain in the transmitter (from the 18 volts) caused the noise that was being registered by the receiver. By reducing the gain, the noise was reduced and we were able to get more accurate measurements. By doing this, however, our effective range decreased. This was not really that much concern because a large range with incorrect measurements is useless. A small range with correct measurements is much more desirable.

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