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Low Cost Wireless Sensor Network Based Intelligent Retina Controlled Computer

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Abstract

A very serious problem has been identified for past many years that paralyzed human beings became isolated from the society for not having a proper existence and due to their reluctances of doing normal life works. Therefore, we have researched on the Human Machine Interaction using Physical Human Body Gestures and came up to proposed solution of the said issue as Low Cost Retina Controlled Computer Using Head mount and Wrist Tilt for Persons who are Paralyzed and cannot be able to move their hands and even they can’t able to walk. Conventionally, we named it as simple as Retina Controlled Computer, is based on Google Glass vision using motion recognition, Zigbee Wireless Technology, Retina Controlled Device that allows human beings with paralysis resulting from Paralysis to do everything on computer even controlling the personal mobile phone using only their Eye and Head movements. This whole project will be based mainly on the new technology of Low Cost Wireless Zigbee Sensors, Arduino Microcontrollers, and motion and retina recognition using Accelerometer. Arduino Microcontroller consists of an open-source hardware board designed around an 8-bit Atmel AVR microcontroller, or a 32-bit Atmel ARM. Therefore, making an Intelligent Low Cost Eye Controlled Computer, based on new technologies will play a vital role in revolutionizing the field of Biomedical engineering and opening the new horizons of research.

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1. Introduction

Advancements in the computer technology, have led to unprecedented new techniques in science and engineering. As the world is tending towards providing technical solutions to the real world problems scientists are researching
extensively for the technical solutions to the real world problems that can help humanity in every way. Human Machine interaction or Human Computer Interaction is one of the major relation in technology that is helping the humanity in every way. Human-Computer Interaction have become one of the most important areas for research and development. Humanitarian technology is the branch of engineering in which technology is working for the benefit of humanity through the direct interaction of the human and machines for solving the real world problems. Humanitarian technologies have now a great impact on the world because of its advancements in the fields of energy, communication, controlling and biomedical systems. Human machine interaction studies the communication between a computer and a human so it takes knowledge from the human side as well as the computer and uses the combine knowledge to benefit humans. The HMI's goal is to improve the interaction between humans and computers by exploring the everyday problems of humans and trying to make machines that can benefit the humans and fix their problems.

1.1. Humanitarian Technology

The Humanitarian technologies are increasing by the time with the specific skills and training that is being required to overcome the problems. The volunteering passion to change the world into a healthy, sustainable and more secure for the living populations has increased the need of the new technologies that help the humanity directly. For that reason, emerging technologies and new techniques and ideas have been implemented including solar powered, biomedical devices, low cost solutions for communications in disaster situations and many other fields. The projects based on Humanitarian technologies have their specific objectives such as helping the person or the community. These are sub divided in three kinds of humanitarian solutions as Disaster, recovery and redevelopment. In this project we have worked on the redevelopment sector of the humanitarian technology and solved the problem of the people who are paralyzed by the attack of Paralysis or Amyotrophic lateral sclerosis (ALS) and make the human body with the only movement of head. Therefore, we have researched over this problem in the initiate stage and then worked on providing them with the solution that is in the range of every person who has been somehow been accidently comes in the range of paralyzed people.

1.2. Problem Description

It has been seen for the past many years that people have been suffered from Amyotrophic Lateral Sclerosis (ALS) or Paralysis that have become one of the rapid increasing fatal diseases that is been noticed as the correct figure of 12000 persons per 100000 in US caught this disease and around 5000 per year are diagnosed with that disease. In Pakistan, almost 18000 patients diagnosed as ALS patients, which is itself a huge number of patients. As a result, many persons get out of the community of the normal persons that made them useless in the community, which is a bitter reality. In this disease, the human body muscles become weaker as the time passes and hence the last stages makes the person not even able to lift himself from the bed. There are many causes having major paralysis and temporary paralysis as well, few of them are describe as it is caused by the damage in nervous system, especially in spinal cord, stroke is another cause of paralysis and it is one of the major causes, other causes are trauma with nerve injury, cerebral palsy, peripheral neuropathy, poliomyelitis Parkinson's disease, ALS, botulism, spina bifida, multiple sclerosis, and Guillain-Barre syndrome, during REM sleep, temporary paralysis occurs and deregulation of this, it can lead to episodes of waking paralysis and curare is a drug, that interface with nerve function also cause paralysis. As a result they make themself away from the community and their life. This problem which we felt as being one of the problems that we can resolve through technology and giving them the life they want to live for themselves. By our proposed technical solution they can not only able to work with the computer but also they can work and earn for their family. Our proposed solution of innovative intelligent wireless human body movements’ computer controlling device can make them able to be part of the community again. This device will make a revolution among the humanitarian technologies. They can do everything while able to control the computer through their head movements. This intelligent device will not only solve the problems of ALS but also help the other people who have been advised to bed rest for long durations.
1.3. Proposed Technical Solution

After an extensive research we have come to a proposed solution for the patients and the people, to develop intelligent Wireless Retina controlled Computer based on Zigbee Wireless Technology. Using this innovative solution we are not only making it intelligently but also made it in lowest possible cost. That is being in the range of every person who needs that. This project will not only work for the betterment of humanity but also make them able to play their important role in improving the economy of the country. This humanitarian technology project will also be really helpful for the hospitals and other medical institutes for different trainings for their patients and can able to let the patients of every kind who are living on bed, to spend their time in useful way. The project is based on Wireless Zigbee based technology and the innovative idea of Google Glasses that is being used to controlling the clicking of the on screen mouse. This project has an important role play of Accelerometer that helps it for motion recognition. The motion detection technique helps to move the cursor to any direction on X, Y plane. The project is also consisted of the Arduino based microcontrollers to control the operations performed. The major achievement to build this project is that it has the plug and play enabled device that makes it easy to use for everyone who wants to take benefit from this. By installing one software of Arduino, it starts working with the help of a software that is easily available for every computer that makes it universal to use for every machine.

1.4. Working Principle Of Retina Controlled Computer

The working principle of the Retina controlled computer is to control the machine through motion of the body. This working principle works with the help of accelerometer which actually detects the positions or in the other words which detects the tilt of the stationary object [1]. The idea is based on providing the solution as wearable technology by using glasses having Eye Blinking detection system installed on that. The working has been done and can able to let the patients of every kind who are living on bed, to spend their time in useful way. The project is based on Wireless Zigbee based technology and the innovative idea of Google Glasses that is being used to controlling the clicking of the on screen mouse. This project has an important role play of Accelerometer that helps it for motion recognition. The motion detection technique helps to move the cursor to any direction on X, Y plane. The project is also consisted of the Arduino based microcontrollers to control the operations performed. The major achievement to build this project is that it has the plug and play enabled device that makes it easy to use for everyone who wants to take benefit from this. By installing one software of Arduino, it starts working with the help of a software that is easily available for every computer that makes it universal to use for every machine. The main advantage of using this wearable technology is that it is portable, easy to use and not a complex machine enough that even some less educated could not able to understand that. The working also includes the movement of the cursor along the x-axis and y-axis. Moreover, the cursor can move in any way in vertical and horizontal manner which makes it uniform for whole screen of computer from Up to down and Left to Right.

1.5. Mechanism and Operation of Working

The project is based on working in three sectors:

- Zigbee Wireless Transmitter Head or Hand Mounted with Accelerometer
- Wearable Digital Glasses To control the computer using mouse protocol
- Zigbee Wireless Receiver Plugged in Computer to display the operations of what a user wants to do with the computer

The operations works first by using the movement of the Accelerometer, as the accelerometer works on the bases of the motion recognition. Hence, while using this multipurpose gadget mounted on head in a stationary position, makes the cursor on the screen of the computer to be stationary without any movement. But when user tilt his head towards left side, the cursor of the mouse on computer moves towards the left side of the screen of the computer. While if the user is moving straight in horizontal x-axis, the cursors moves smooth in horizontal. And if the user, makes his head towards right side in horizontal direction then the cursor moves towards right direction[2].

There is a case when a user makes his head downside in vertical direction, y- axis, then the cursor of the mouse
goes downwards. And when the user moves his head upwards then the cursor moves in up direction vertically. Now, considering a case when the user wants to select something on the desktop screen on cross-direction. In that case, the user makes his head in that direction that it can also make a stair-case like movement in upwards and downwards, although this can be difficult for the user to do several movements from head in horizontal and vertical directions. The working is based on the three sectors in which the first sector takes input from the motion of the head movement in x-axis and y-axis direction along with that it takes input from the eye blinking mechanism. Then it sends the inputs to Arduino UNO R3, which compares the inputs and sends the input to the Zigbee Wireless Transmitter. Then the Zigbee Transmitter end sends data to the receiving end of the Zigbee transmitter, where it sends data to the Arduino LEANARDO microcontroller that works on using the wireless mouse protocol and sends signals to the computer to perform the tasks as normal mouse performs.

The eye blinking mechanism works on the principle of detecting the bright frames comes when eye blinks. We have set the values for double blinking of eyes to open up a folder in windows. Whereas single blinking will do the selection of any object. Moreover, for the right click on screen, we have made the left eye blinking for this purpose. The main purpose of using Infrared LEDs for blinking purposes is to make this mechanism as simpler as it can be to reduce the cost of manufacturing of the product. These Infrared Sensors actually work on the basis of transmitting the light and the light which is being reflected from the pupil of the eye that is being recorded by the receiving LED, which sends signal as 1 to Arduino to give it a signal of clicking. Hence, as the signal receives by the arduino uno, it takes the data from the accelerometer and compares both results it transmits to Zigbee wireless transmitter module to transmit the signal which then received on the other end having another arduino leanardo that works on wireless mouse protocol. This whole process works just as depicts as follows.
1.6. Schematic of the Retina Controlled Computer Using Wireless Sensor Network

Following is the block diagram of the receiving and transmitting end of Retina controlled computer having zigbee interface as communication medium between human section and computer section:

The above schematic clarifies the concept that firstly it takes the input from the glasses having infrared sensors in it, then it sends the data to the amplifier and then Analog to Digital Converter that converts the signals to digital and sends the signals to the Arduino UNO R3, which combines the inputs of the Accelerometer and the glasses and gives to Zigbee transmitter to transmit the signals. This circuit is being powered by the 9V battery, and the H-Bridge of diodes. On the other hand, the receiving unit actually works as the reverse of the transmitting unit. It takes the signals from the Zigbee Transmitter and then amplifies this signal to forward it to Arduino Leonardo which has a built in feature having two USB ports which specially works for USB keyboard and mouse. It helps in making the signals into the format in which the computer reads instructions coming from the accelerometer and the eye blinking mechanism. The circuit is then connected to computer for performing specific operations as processed.

In this project the wireless communication feature has been installed to make this project portable and easy to use while sitting anywhere around the room. It also makes it simpler to use for the user. Moreover, the portable feature has been installed to provide the new technology in really less expensive and reliable format in every way [5]. The Zigbee transmitter and receiver actually works on 2.4 GHz frequency using a protocol and standard of IEEE 802.15.4. And supports the unique needs of low power, low cost wireless transmission. These modules can communicate in any voltage compatible and logical UART or any RS 232. These modules can be set at a range of 100 meters inside the room that makes it more convenient for the patients to move around the room using computer [6]. This wireless communication will also be helpful in controlling the hand gesture movement along with head movement.
2. Conclusion

The Zigbee based intelligent Retina Controlled Computer is the best solution for the people who are disabled due to paralysis or other diseases in which they are unable to move their body. This project is not only been vision at providing help to the disabled but also give a unique feature to open up the fields of Eye tracking. Moreover, this project that is made in a lowest possible cost ever using Zigbee Wireless Technology that make this project more reliable. As well as, Arduino Leonardo and Arduino UNO R3, makes this project unique as leonardo works on the same protocol as mouse works, and the Arduino UNO R3 works for comparing the inputs coming from Eye Blinking mechanism for clicking information along with the accelerometer that takes information of the tilting position. This information then transmitted to the Zigbee Transmitter where this data transmits to Zigbee Receiver, where receiver forwards this information to Arduino Leonardo that converts the all inputs to the Mouse Protocol as computer operates in normal way. Arduino Leonardo then converts this data to mouse protocol using an ongoing windows based Arduino Software that converts the signals to make input as a normal mouse gives input for the computer to operate as mouse. This technique has numbers of applications specifically humanitarian technology based applications such as Eye controlled Wheel Chair, Eye controlled Car driving and there are many other things. Hence, making it in lowest possible cost actually make it easier to purchase for everyone

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