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A Contact Switch Wired Data glove Technique for 3D molecular Application

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Abstract – *This paper present the development of a new dataglove technique based on a contact lever switch. The dataglove is developed in order to render with 3D molecular object virtually. Here, the analysis of five fingers flexing of the glove are done using contact switch. The main purpose of the dataglove is to provide the natural input in virtual appearance. The purpose of the project is to develop an application of molecular library containing atoms and bonds 3D visualization and apply human rendering dataglove technique. The aim is to help student and researcher in molecular science learning process in understanding physical structure in real appearance which is easy and enjoyable to users. The experiment shows that the glove id capable to move the 3D molecule in 180° degree of freedom in x, y, and z axies.*

***Key Words*: Virtual environment, Molecular Dynamics, 3D Graphics, Computational Chemistry, Contact switch, Arduino Microprocessor.**

1. INTRODUCTION

Now days there are various researches done for the development of dataglove technology. Dataglove is most commonly used technology for gesture interaction [1]. Mainly, this technique is used for human computer interfacing. It usually helps user to interact the world virtually and serves as an input device in a non-verbal-communication [2]. Basically, till now the commercial datagloves usually use expensive sensors which are consequently too costly [3]. Technological revolution has made positive effect within the field of science studies of molecular chemistry and biology and provides direct engineering solution for human computer interaction.

Compared with traditional devices, hand gesture is used in a wide range of application such as sign language, 3D object manipulation and visualization into virtual environment [4]. For example, user can navigate a 3D virtual environment and also able to manipulate the virtual objects with gesture commands without the help of keyboard. Therefore, for exploring the advancements, the 3D atomic bonds are created as an object to be communicated with the dataglove. The various types of 3D molecular objects are created and manipulated using dataglove technique. However, images will never support a complete representation of reality. Thanks to technological enhancements, that it brings the possibility to explore the aspects of reality to us. Using interactive tools and modern visualization techniques, it made possible for the hand-on perception of molecule interaction [5]. The embedded in science instructions have a direct and personal experience with atomic bonding and build molecule on the screen. The aim of the project is to build an interactive design of molecular structure, build atoms and bonds in 3D view that allows the users to feel the real time experience. The following section describes the design and implementation and discusses that how interfacing and navigation are done.

2. Background

After physics in 17th century, chemistry has been involved in the process in 19th century. The specific topics of chemical research has developed with different mathematical methods to enhanced the science study that aid an attractive understanding to molecular world [6][10]. Programming language creates a new avenue of exploration and collaboration in chemistry that developed a virtual reality of chemical structure.

Hamdi and Sharma *et al.* [7] in 2007, developed a molecular dynamics software (NAMD) which was coupled to VR. This software design and characterize the physical simulation and simulate the behavior in 3D visualization for protein based structure. They coupled VR to computational MD and quantum dynamics to simulate and visualize the complex architecture. Some of the implementation uses OpenGL to design the VR hand simulator [11]. Visual feedback is implemented with 3D virtual hand.

Lucas and Andre *et al.* [8] developed a low cost dataglove based on Arduino for VR application. They developed a new approach for controlling a video game application for rehabilitation of stroke Patients. Paper [12] describes an intelligent computing system to assist clinicians. They use accurate angle measurement of digits in human hand with 5DT 14 ultra dataglove. This system had made possible creating an application that capture the movement from each finger and display in numerical and graphical form in real time.

Hanan Teleb *et al.* [9] Creates a hand model which interacts with object on screen using collision spheres on mesh joints. Teleb used the application “Milkshape 3D”. Sivate and Murray [13] present us with third version of low-cost bimanual rehabilitation system. The system was designed for in-home use by post stroke patients. Their aim was to improve hand upper extremity function.

Edward *et al.* [14] describes a study of virtual reality learning objects of molecular structure. The aim was to describe the purpose of learning object and its development. It support understand of molecular structure by using multimodal VR technology. Author analyses the possibility of the application and limitation of technology to aid an approach to further research. They developed a virtual model of a DNA molecule that is used in biochemistry. Thus, by studying all those aspects of literature, this paper discuss the newly approaches that is fully operated by using dataglove interface device using Contact switching technique. And it mainly focuses on building molecular library management application that builds the molecule in 3D view that allows the human computer interaction using dataglove.

The goal is to:

- To provide molecular simulation program for science learner to explore their knowledge in scientific studies.
- To provide the human computer interface into real world to develop the practical knowledge about chemistry that is enjoyable to user.

3. Proposed Method

3.1 Dataglove design

As discuss, all traditional system uses the various types of sensors to developed dataglove. The research present with new dataglove design using Contact Lever Switch (16A 220VAC) technique. The contact switches are embedded into hand glove. Electronically, reliable switches with switching currents are 20 to 21 A.

Fig 1. Contact switch

Designing the glove in development process would be more interesting when priority is to wearer comfort and effectiveness. Therefore, for measuring force of the 3D molecular object, contact switch is used with the property of pressing or bending. The basic operation of switch is simple. When switch is press by the fingers (each finger are assign with switches) the binary digit will get generated and hence the output result is measured simultaneously to create virtual appearance of 3D atoms and bonds along with given operation.

3.2 Interfacing

Dataglove mapping experiment process is carried out by using interface card to show the reliability with VB.Net application. Signal from interface card resistivity will be evaluated so that the signal will get compatible to be analyzed and well matched with VB.Net application. Fig 2. Shows the simulink diagram for basic setting for data reading to establish the connection between microcontroller and computer VB. Net software installed.

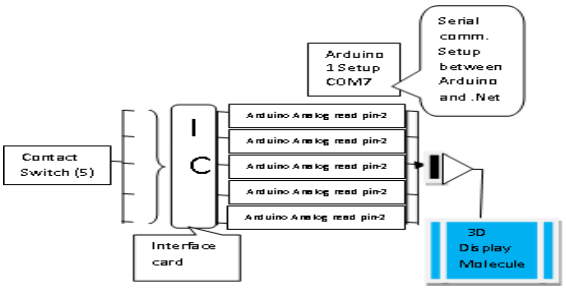

Fig.2 Simulink diagram for Basic Setting

Basically, the Arduino IO library must be pre-install in .net application, while programming for serial communication that is integrated into the Arduino UNO. Massimo Bunzi the founder of Arduino states all the setup and basic information related to Arduino system [15]. COM7 is the location of Arduino which is connects to USB ports. The Arduino output multiplies the input data by the constant value. The gain block helps to unfiltered data from glove pressing activities of five fingers at the range and can rotate at 180° degree for all operation. Fig 3. Shows LED glowing when the input from the dataglove is received on pressing switch for x operation.

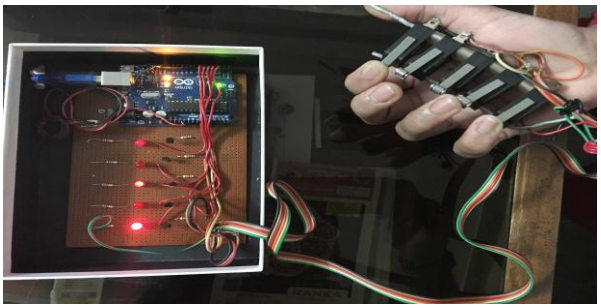

Fig. 3 LED output on Dataglove input

3.3 Arduino microprocessor

Development and design process of implementing dataglove and its mapping would be more interesting when priority of designing is to wearer comfort and effectiveness. The proposed dataglove is planned to measure several DoF with the help of Contact Switching. Arduino Microprocessor [15] is used as a communication interface of the electronic components. It communicates system that function a sense to environment by receiving the variety of input and affects its surrounding by controlling them.

4. 3D Molecular Library

The primary tool used for visualization, simulation and generation of 3D diagrams is VB.Net application. Generally many researcher uses MatLab in stepping stone for the

translation between the dataglove and the system. But the effectiveness in carrying and using the VB.Net application is that the project is consisted of analyzing a terabytes size database. The numerical and standard mathematical algorithms are complicated to create the 3D virtual objects of Atoms. So, using something different to MatLab, was to use VB.Net application to query the database as project uses the backend as Microsoft access to retrieve the values of atoms and bonds. The conclusion was to use VB .Net tool according to the strength of the project for creating virtual objects.

Various methods can be used to ensure the final results. The application is capable to analyze the entire signal received from dataglove via interfacing port. VB.Net has all the important possibilities of building the 3D model of given object. It provides all the facilities important for virtual world capabilities. The 3D molecule created is encapsulated in stored procedure to backend and the output is return to files. Meanwhile, the dataglove is capable to measure and translate 5 operations of rotations on the displayed molecular object. It also able to performs movement of atomic bonds in x, y and z axis. It also performs an arbitrary rotation towards x, y and z axis. It move and display the molecule in all views in 3D. Fig 4. Shows the experiment carried out for Ammonia molecule rotating at x-axis when the operations are carried out by data glove.

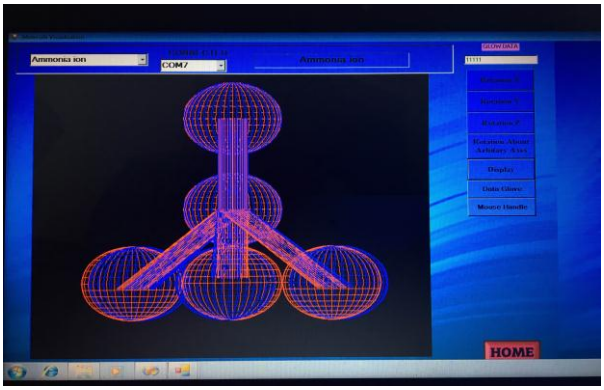

Fig 4. Computerized Molecular Simulation

Abstract concept and process are visualized in virtual animated model. The remaining operation is under work. The paper satisfies the activities of the dataglove implementation and setup in application. The switching process is successfully indented to provide an appropriate signal to microprocessor and then signal from Arduino to virtual program directly. It made possible translating the movement of 3D molecular object. It :

- Allows complex molecule to create, update, stored and retrieved.
- The database stored information about the molecules atoms and bonds, periodic table for retrieving molecule.
- The 3D object viewing functionality of molecule movement displaying in all views rotating to x, y, z – axis and arbitrary movements, so that user can view molecule from different sides.

5. Advantages, Disadvantage and Application

Virtual reality with human computer interaction technique is the area of tremendous growing research now a days.

5.1 Advantages

1. Uses information about how human interact with the physical world to help identifying the molecular object.
2. Accurate recognition with a small set of motion for trained users.
3. The hand glove recognition allows users to accomplish frequent and common tasks using hand to interact with computer, instead of using traditional keyboard and mouse setup.

5.2 Disadvantages

1. Requires training by more than one person for accurate results and user independence.
2. Requires normalization to keep image constant.
3. Does not use hand orientation and position data or finger data.

5.3 Application

1. Chemistry study
2. Pharmaceutical
3. Molecular Bio-Science
4. Virtual Reality
5. Material Science

6. CONCLUSION

The meaningful knowledge created about molecular geometry has always been challenging for students in learning chemistry. The enhancement with those modern technology and haptic tools allow educators at all level to open a new world of virtual science to students. The objective is to design a low cost dataglove that is able to generate real time response with contact switch are press. The paper presents the design and implementation of dataglove and its interaction to the virtual 3D molecular management system. Three operations are successfully implemented and operated by dataglove. The implementation is able to generate 3D molecular atoms that measures and rotate in 180° degree of freedom. The research indicates that virtual reality have proved it-self in creating a meaningful learning in scientific concepts which is enjoyable and understandable to users.

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