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Wearable Exoskeleton Robotic Device for Upper Limb by Using 3d Printer

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Abstract: *Dyskinesia of upper limb caused by stroke,sports injury, or traffic accident limits the ability to perform the activities of daily livings. This systems caused by numbness of face, arm and legs. It affects the person one side of the body recently the use of hand exoskeleton for assistance and motor rehabilitation hasbecome increasingly widespread. Most of the 3D exoskeleton are customized, replication andmaintenance as a low cost. We are used to predict the stroke patient based on arm band, STM 32 controller and gyro sensor to increasing the repetition movement and enhance their function. This device can use out of the hospital environment.*

Keywords: *3D printed, STM 32 controller,arm band, exoskeleton robotic device, upper limb.*

1. INTRODUCTION

Exoskeleton then has been in making since the 1960s. Voluntary hand movements are generally bloodied after a stroke, cerebral paralysis, spinal cord injury, affecting millions of people per time worldwide. Exoskeleton then refers to any wearable frame on the mortal body which eases andsupports the muscles to perform work with letter strain and great comfort, using mechanical sectors and electrical power . Then, we're using the STM 32 regulator. It's that part of the robot which operates the mechanical arm and maintains contact with its terrain. The robotic exoskeleton upper branch is combined software and tackle of computer composed in enable it to carry out its assigned tasks. The most important exoskeleton is the guardian of the system allows is driver to lift objects weighting up to 90KG (200 lbs). Exoskeleton can be made from made from accoutrements similar as carbon fiber, essence andelastic. Their content also varies from the entire body, to lower or upper extremities or to a specific body part like the shoulder ankle, wrist, hipsters or ankle. This technology is used in complex reconstruction of the shoulder, arm, knee, hipsters and pelvis for individualities with sarcoma or metastatic cancer. Pobol supported recuperation can ameliorate the motor functions of the cases branches with applicable treatment. Soft exoskeleton is suitable to drop the weight of the device due to its light in nature. The device is light weight, movable, flexible, ergonomics system affordable customization and among other advantages. Exosketon are used to support body weight, help with lifting, help maintaining loads or stabilize the stoner's body. Roughly 4000 stroke cases are daily in India.

1.1 Existing system: Our being system are a 3D published soft exoskeleton robotic glove for disabled hand recuperation and backing. Flexible glove modulewhich serves as string attendance for flexion and extension of cutlet consists of win section, mesh- like string guard, fritters and semi-rigid thumb brace. The win section of the flexible glove provides an interface between the fritters and **actuation**/control unit. To design a glove that is flexible and comfortable to wear and robust in long term operation, major factor to be considered is the choice of the material. Considering these conditions,the material of glove is chosentbe in thermoplastic polyurethane with reinforcement ardness 90A. This device uses the accelerometerdetector. It will not give the accurate movement. In the chosen design for the glove, four active independent degrees of freedom, one per cutlet are enforced. Grip strength and range of stir of the gloves aren't little bite of satisfy the conditions in performing conditioning of diurnalliving. Exoskeleton glove aren't lifted the heavy object.

1.2 Proposed System: Our proposed system was wearable robotic exoskeleton device by using 3D printing. The device will be give support for hand disability person. It's low cost, flexibility, comfortable, movable, light weight and stoner friendly one. As numerous pieces as possible should be made with 3D printing to allow simple low- cost reduplication, affordable conservation and easier customization/revision. The exoskeleton structure should communicate the reverse on hand, in order to free the win, fritters so as to preserves a more natural grip of object. We are modifying the STM 32 microcontroller it can prognosticate the accurate movement. The stoner should be suitable to spark both flexion and extension of the hand with the help of exoskeleton device. A single 270 degree servo motor is used to transmit stir to all fritters of the exoskeleton. Then, we're using gyro detector for the accurate movement. Senses angular haste produced by the detector's own movement. It support body weight, help with lifting, help maintain loads, or stabilize the stoner's body. Exoskeleton low for faster movement then exoskeleton but the muscles are less flexible than an beast with a hydrostatic shell. Adding stoner independence.

BLOCK DIAGRAM:

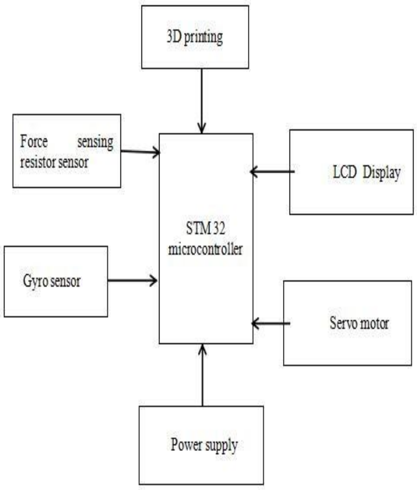

FIGURE 1. Block diagram

2 COMPONENTS: HARDWARE DESCRIPTION

2.1Servo motor: Servo motor works on PWM (Pulse width modulation) principle means its angle of rotation is controlled by the duration of applied pulsation toits Control hand. Basically servo motor is made up of DC motor which is controlled by a variable resistor (potentiometer) and some gears. It can be run to spark an actual movement to exoskeleton.

FIGURE 2. Servo motor

2.2Gyro sensor: Senses angular velocity produced by the sensor's own movement. Angles are detected via integration operations by a CPU. The angle moved is fed to and reflected in an application. Senses vibration produced by external factors, and transmits vibration data as electrical signals to a CPU. It is an extra support to the muscle. It can be control the speed and measure the force to the muscle. It can be exoskeleton.

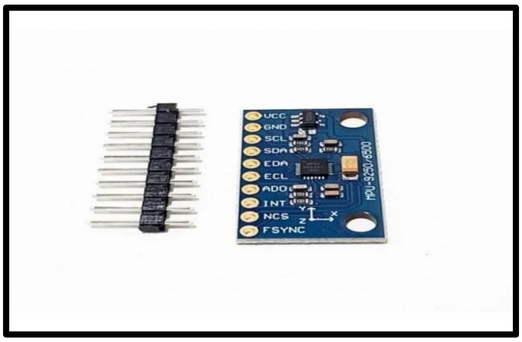

FIGURE.3 Gyro sensor

2.3 Accelerometer sensor: The main working principle of an accelerometer is that it converts mechanical energy into electrical energy. When a mass is kept on the sensor which is actually just like a spring it starts moving down. Since it is moving down it starts experiencing acceleration. It is an only purpose of force to the muscle of exoskeleton device to be a decision making.

2.4 STM 32 Controllers: The STM32 intrude system is grounded on the ARM Cortex M core NVIC supplemental. The STM32 MCUs support multiple mask able interrupt channels piecemeal from the 16 intrude channels of the ARM core. For illustration, the STM32F1 MCU series supports 32 maskable interrupts. It is prognosticate an accurate movement of the exoskeleton. We are using 12 bit ADC board.

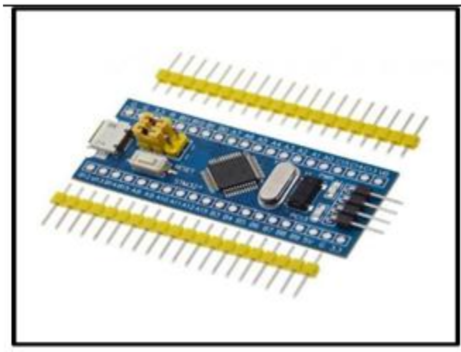

FIGURE 4. STM 32 Controllers

2.5 LCD Display: Principle of liquid crystal display Without any voltage applied between transparent electrodes, liquid crystal molecules are aligned in resemblant with the glass surface. When voltage is applied, they change their direction and they turn vertical to the glass surface.

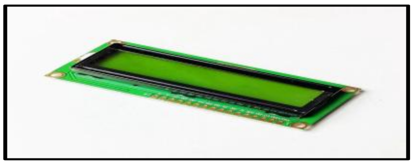

FIGURE. 4 LCD Display

2.6 Arm Band: The detectors are distributed in a way that they can cover some areas of muscles, esspecially, wherethey can read the maximum normal force. The flexibility of strap ensures a good contact between FSRs and arm muscles, which allows the FSRs to sense the normal force wielded by the muscles on them.

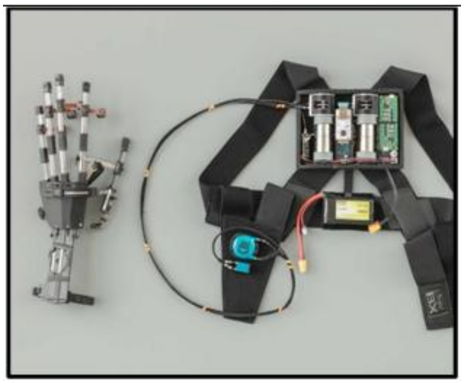

FIGURE.5 Arm Band

3 SOFTWARE DESCRIPTIONS

3.1 Cura Software: **Cura** is an open source slicing operation for 3D printers. It was created by David Braam who was later employed by Ultimaker, a 3D printer manufacturing company, to maintain the software. Cura is available under LGPLv3 license. Cura was originally released under the open source Affero General Public License interpretation 3, but on 28 September 2017 the license was changed to LGPLv3. This change allowed for further integration with third-party CAD operations. Development is hosted on GitHub. Ultimaker Cura is used by over one million users worldwide and handles 1.4 million print jobs per week. It is the favoured 3D printing software for Ultimaker 3D printers, but it can be used with other printers as well. Simplified stoner interface. Ultimaker Cura's new stoner interface accommodates a range of skill levels and workflows. Three stages in the header clearly guide the process: prepare models in the prepare stage, simulate the 3D printing process in the preview stage, and monitor print progress for Ultimate printers in the monitor stage. Collapsible panels give you easy access to settings, and allow you to focus on your 3D model as needed. Recommended mode enables you to prepare prints quickly and easily, relying on the strength of expert-configured print profiles. Custom mode gives you full control, with the power to adjust over 300 separate slicing settings, and an adjustable panel to keep all your settings visible.

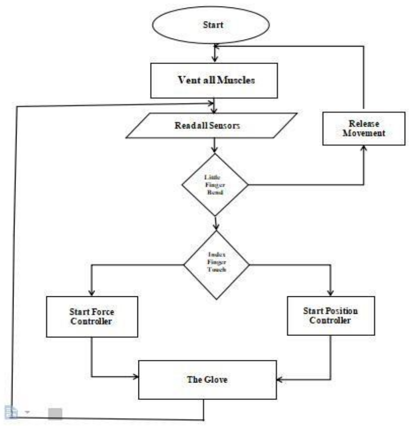

FIGURE. 6 Flow chart

3.2 Arm GCC Compiler: The R Kit-ARM tool chain is a complete tool set including C compiler (based on GCC),Assembler and Linker for creating software applications for ARM core-based microcontrollers.The C compiler toolset for ARM provides unlimited, optimized compilation of your C/C++ source files.The compiler is seamlessly integrated into the Ride7 integrated development environment to facilitate starting projects and multiple builds/rebuilds of your application as you debug and fine-tune it. The Ride7 IDE is tailored to creating embeddessd applications and delivers the views you need to understand exactly whats happing while the application executes on your microcontroller. In addition, Resonance has optimized the compiler and libraries for improved performance that is tailored to the needs of deeply embedded applications. The compiler toolset is available for download as part of our RKit-ARM software installation. It is also delivered with a range of hardware products including the RLink debugger/programmer, REva starter kit and Primers for ARM core-based devices.

4. METHODOLOGY

Developing a wearable exoskeleton robotic device for upper limb using 3D printing requires a well- defined methodology to ensure the success of the design. They are some suggested way:

4.1Define the Design scope: Clearly define the objectives of the Design and the stoner population. This includes determining the specific functions and capabilities of the exoskeleton device.

4.2 Conduct a literature review: Conduct thorough review of existing literature and exploration related to upper limb exoskeletons and 3D printing to identify crucial design considerations, specialized challenges, and stylish practices.

4.3 Identify design conditions: Grounded on the design compass and literature review, identify the design conditions and constraints for the exoskeleton device. This includes factors similar as ergonomics, weight, strength, and safety.

4.4 Develop design conception: Grounded on the design conditions, develop a abstract design for the exoskeleton device. This should include a detailed CAD model of the device.

4.5Prototype the device: Use 3D printing to produce a physical prototype of the device. This prototype can be used to estimate the feasibility of the design and identify any implicit issues or areas for enhancement.

***4.6 Conduct testing and evaluation**:* Conduct a series of tests and evaluations to assess the performance of the exoskeleton device. This includes testing for ergonomics, strength, safety, and functionality.

4.7 Upgrade the design: Grounded on the results of the testing and evaluation, upgrade the design of the exoskeleton devices necessary. This may involve timber adaptations to the CAD model and creating fresh prototypes for further testing.

4.8 Finalize the design: Once the design has been refined and all necessary testing and evaluation has been completed, finalize the design of the exoskeleton device. This includes creating a final interpretation of the CAD model and generating all necessary attestation.

4.9 Manufacture the device: Use 3D printing to manufacture the final interpretation of the exoskeleton device. This can be done using a variety of accoutrements depending on the specific design conditions.

4.10 Conduct stoner testing: Once the device has been manufactured, conduct stoner testing to ensure that it meets the requirements of the target population and is safe and effective to used. Make any necessary adoptations to the design grounded on stoner feedback.

5 RESULT

The design specification for the hand exoskeleton. We are used to predict the stroke patient movementby using STM 32 Controller, arm band and various sensor. It can predict the accurate movement of the stroke patient..The exoskeleton device is low cost , 3D printable, lightweight, fully wearable, portable and suitable for home use.

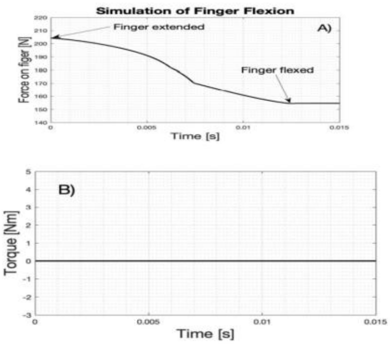

FIGURE 7.

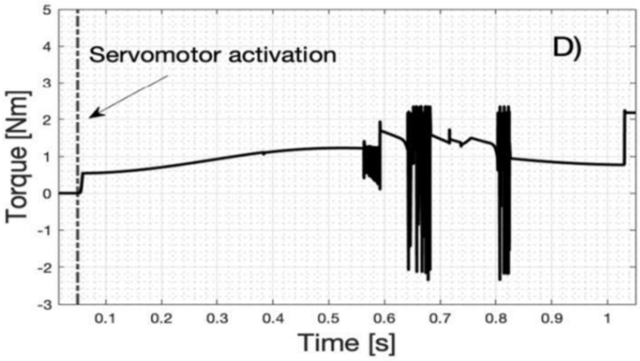

FIGURE 8.

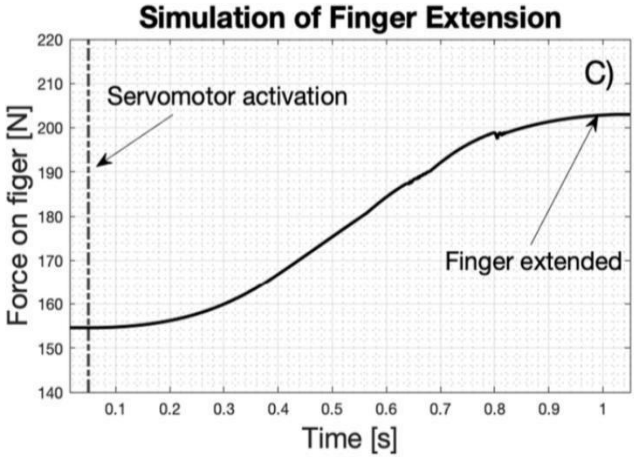

FIGURE 9

6. CONCLUSIONS AND DISCUSSION

We had designed and characterization of a flexible exoskeleton arm for backing and recuperation of cases with disabled hand functions. The robotic exoskeleton for the upper limbs have gained great scientific interest in the areas of engineering and development of soft wearable devices for the support of daily life condition of the upper limbs is a promising and growing exploration field areas 3D printing, also known as addictive manufacturing, is a system of creating a 3-dimensional object sub caste by using computer created design.

REFERENCES

[1]. Discrete Controller for zeta Converter, vijayalakshmi, S. Saju, marimuthu, Journal ofapplied science nd computation.vol no:5 Issue no:11 page no:593-611

[2]. Upper limb soft robotic wearable device Elena Bardi, Marta Gandolia, Emilia,Ambrosini Journal of neural engineering and rehabilitation. Vol no:19 Issue no:87 Page no:1-9 2022.

[3]. Development of a wearable upper limb rehabilitation robot based on reinforced soft pneumatic actuator Xinbochen,Shuai Zhang,Jlantao Yao. Journal of mechanical engineering. Vol no:35 Issue no:83 Page no:1-9 2022.

[4]. AI based wearablerobotic exoskeletonsfor upper limbrehabilitationManuel Andres Velez-Guerrero,Mauro Caujas-Cuerro, Stefano Mazzoleni Multi disciplinary digital publication institute.Vol no:21 Issue no:46 Page no:1-29 2021.

[5]. Gandolla M, Dalla Gasperina S, Longatelli V, Manti A, Aquilante L, D'Angelo MG, et al. An assistive upper-limb exoskeleton controlled by multi-modal interfaces for severely impairedpatients development and experimental assessment. Marta Gandolla, Stefano Dauo Gasperino Rob Auton Syst. Journal of Sciencedirect Page no:1-9 vol no:143 Issue no:0921-8890 2021.

[6]. 6. 2.Xiloyannis M, Alicea R, Georgarakis AM, Haufe FL, Wolf P, Masia L, et al. Soft robotic exosuits: state of theart, core technologies and open challenges. IEEE Trans Robot. 2021. https://doi.org/10.1109/TRO.2021.3084466.
[7]. 7. 3.Longatelli V, Antonietti A, Bif E, Diella E, D'Angelo MG, Rossini M, et al. User-centred assistive SystEm forarm Functions in neuromuscuLar subjects (USEFUL): a randomized controlled study. J Neuroeng Rehabil. 2021;18(1):1–17.
[8]. Kapsalyamov A, Hussain S, Jamwal PK. State- of-the-art assistive powered upper limbexoskeletons for elderly. IEEE Access. 2020;8:178991–9001**.**
[9]. Tschiersky M, Hekman EEG, Brouwer DM, Herder JL, Suzumori K. A compact mckibben muscle basedbending actuator for close-to-body application in assistive wearable robots. IEEERobot Autom Lett.2020;5(2):3042–9.
[10]. O'Neill C, Proietti T, Nuckols K, Clarke ME, Hohimer CJ, Cloutier A, et al. Infatable soft wearable robot forreducing therapist fatigue during upper extremity rehabilitation in severe stroke. IEEE Robot AutomLett.2020;5(3):3899–906.

[11]. Thalman C, Artemiadis P. A review of soft wearable robots that provide active assistance: trends,common actuation methods, fabrication, and applications. Wearable Technol. 2020;1:1–27.

[12]. Georgarakis AM, Song J, Wolf P, Riener R, Xiloyannis M. Control for gravity compensation intendon-driven upper limb exosuits. Proc IEEE RAS EMBS Int Conf Biomed Robot Biomechatron.2020;2020:340–5.

[13]. Asgari M, Hall PT, Moore BS, Crouch DL. Wearable shoulder exoskeleton with spring-cam mechanismfor customizable, nonlinear gravity compensation. Proc Annu Int Conf IEEE Eng Med Biol Soc EMBS.2020; 2020:4926–9.

[14]. M. B. Yandell, D. M. Ziemnicki, K. A.. Mc Donald, and K. F.. Zelik, "Characterizing the comfort limits of forces applied to the shoulders, thing and shank to inform exosuit design," PLos ONE, Vol no.15, no.2,2020.

[15]. Wearable robotics for upper limb rehabilitation and assistance Rejin Varghese, Daniel Freer, Jindong Liu Research gate. Page no:1-41 Vol no:20 Issue no:82 2018.uiuu