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Smart Walker Instrumentation Using Hand Gestures

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Abstract: The passive walker devices currently in use may steer or brake spontaneously, requiring the user to urge them ahead. This project creates a smart walker system with sensors and actuators for enhanced support and assistance. Here, the user controls the walker with hand gestures. Better physical support, sensory support, cognitive support, health monitoring, and human-machine interface are the key benefits. The method incorporates gyroscopes that measure the angles of hand movements and start the smart walker moving in the user's chosen directions. The temperature sensor, EMG sensor and gyroscope are used, to measure the health factors such as temperature, muscle activity and leg position angles and hand angles. Arduino is used as a control unit. It is mostly applied for the use of senior persons and people with lower limb disabilities during the rehabilitation stage.
Keywords: Smart Walker, Hand Gestures, Gyroscope, EMG Sensor, Rehabilitation.

I. INTRODUCTION

The percentage of people in the world who are 60 or older has been rising rapidly, and by 2050, that figure is expected to reach 21%. As the population ages it is crucial that people continue to be active and move around. Impaired mobility of older adults is linked to a loss of independence, decreased quality of life, institutionalization, and a higher risk of mortality. Unfortunately, impaired mobility is prevalent in 44% of older adults. Mobility aids range from simple external devices such as canes to mobile vehicles such as wheelchairs. Canes can reduce falls in patients by increasing gait stability, but they provide minimal weight support. Wheelchairs can transport people who cannot move by themselves, but excessive sitting can cause deterioration of health. In between the two lie walkers. Walkers provide support for weight and balance but require patients to use their own locomotion, thus minimizing deterioration of mobility. Rollators, or wheeled walkers, are particularly liked for their usability and support for natural gait patterns.

Smart walker system is equipped with sensors and actuators for better assistance and support. Our system is mainly providing better physical support, sensory assistance, cognitive assistance, health monitoring, or human-machine interface. Here we are going to design a smart walker system which can operated through hand gesture moment because Passive devices may steer or brake automatically but require the user to push them to move forward while active ones can actively control the movement and our system monitors several parameters of the human who uses our system like temperature ,EMG ,and leg movement and analyze and give the entire report to mobile.

II. LITERATURE SURVEY

A. A Smart Walker For People With Both Visual And Mobility Impairment

Nafisa Mostofa et al.,2021[8] proposed a system that has four distinct smart walker configurations in this work with a focus on the requirements of those with vision and mobility limitations. They investigated several software setups, user interface modalities, and sensor technologies (ultrasound-based, infrared depth cameras, and RGB cameras with powerful computer vision processing) (haptic and audio signal based). They find a mechanism to communicate the obstacle to the user in a way that prompts the appropriate real-time obstacle avoidance behaviour is just as important as having a sensor that detects it. This system's navigation is highly complex, and it depends on previous basic observations for navigation. The system is relatively pricey in price. Our proposed system is comparatively low cost and provides smooth locomotion.

B. A Review On Smart Walker For Antalagic And Ataxic Gait Population

Gokul et al.,2018[14] proposed a paper where the main concern is the population of people with ataxic and antalagic gaits. Both people share the issue of having an incorrect body weight balance while walking.

It is possible to prevent their unneeded pain and modify their walking pattern by constructing an automated smart walker with a balance management system, fall management system, and light aid system. This device will collect the subject's dynamic EMG and transmit it to the concerned physiotherapist. The EMG data from the patient is transmitted through Bluetooth to the therapist for ongoing and periodic evaluation of muscle re-education. Whereas Bluetooth can only transfer data over about 10 meters, our system has a WIFI module that can transmit data over a distance of 125 meters and also offers a suitable body weight balancing walker

C. Physical Rehabilitation Based On Smart Walker

Carlos Nave et al., 2018 [10] created an intelligent walker rehabilitation system was created by Important gait parameters, such as the walker's elevation and orientation angles, are collected and stored by the system. The device also enables the physiotherapist to view the session's data in real time and gives a comparison of the last five patient sessions for the purpose of evolution diagnosis. They want to recognise the gait patterns and balance the variances in the future. ECG sensors are also something they intend to introduce.

D. Mechatronic Improved Smart Walker

Selshiya S et al., 2017 [4] proposed an age-related health conditions, such as high blood pressure, cardiac disease, arthritis, etc., are more common among elderly persons. Most elderly individuals rely on walking sticks for support. In this work, we improve the walker utilising cutting-edge technology to track physiological indicators taken from older persons and notify a family member or carer using an alarm and GPS. In order to better help our elderly, we are introducing the automated ambulation walker known as the "smart walker." This device uses an ultrasonic sensor to identify impediments in its path, and if it detects any, a buzzer will sound to inform the user. Elderly folks cannot use the traditional walker at night since it does not have a feature to increase visibility. By adding LDR, which automatically turns on and off the light based on the user's choices, this issue is resolved in our smart walker. The user's location is also tracked using GPS, and all this information will be transmitted with their carer or doctor in case of an emergency by sending a message using a GSM module.

E. Ultrasound Based Smart Walker With Data Sharing System

Joana Alves et al., 2021 [6] a device that is utilised as a medical treatment for gait disorder patients' rehabilitation. This device was created and improved into an enhanced and dependable system from a mechanical and electronic standpoint to fulfil the needs of the user. The suggested system is utilised in physical therapy to assist patients in recovering from their motor disability and regaining confidence in their ability to move around. Given that this walker is a complex system with numerous component interfaces, Due to that our system uses fewer components, it can resolve all these issues.

III. METHODOLOGY

A. Working

The Arduino microcontroller is used in this circuit. The power supply is given from the 12V battery to the whole circuit. The buck converter is used to convert 12V battery power supply to 5V power supply, since Arduino requires only 5V power supply. The gyroscope is used to measure the angles of the hand gestures of the lower limb impaired people. The angles measured is converted into signal by the gyroscope. This signal is used to drive the smart walker equipment. The H-bridge is used as actuators for the Direct Current motors. Our system is equipped with gloves that is attached with gyroscope. The gloves can be worn by the lower limb impaired person. After wearing, the person can keep their hands on the arm resting pad for support. Thus, the smart walker bears the weight of the lower limb impaired blind person. Hence the pressure applied to lower limb is much reduced. When the hand glove attached with gyroscope is moved, the H-bridge gets activated and drives the Direct Current motors. The motors induce movement in the wheels of the smart walker.

Now, when the hand is moved upward the smart walker moves backward. When the hand is moved downward, the smart walker moves forward. When the hand is moved rightward, the smart walker moves right side. When the hand is moved leftward, the smart walker moves left side. The ultrasonic sensor used in the smart walker aids in detecting the obstacle that occurs in the path of people, thus they are alerted with the upcoming obstacle. The Electromyography Sensor is placed in leg of the human to analyze their leg improvements.

Temperature sensor is used to analyze the temperature of the person's leg. The measured values from Electromyography Sensor, Temperature Sensor, Ultrasonic Sensor are transmitted to the cloud through ESP8266 Wi-Fi module. The values can be reviewed by doctor lively in the mobile/ computer system using software application.

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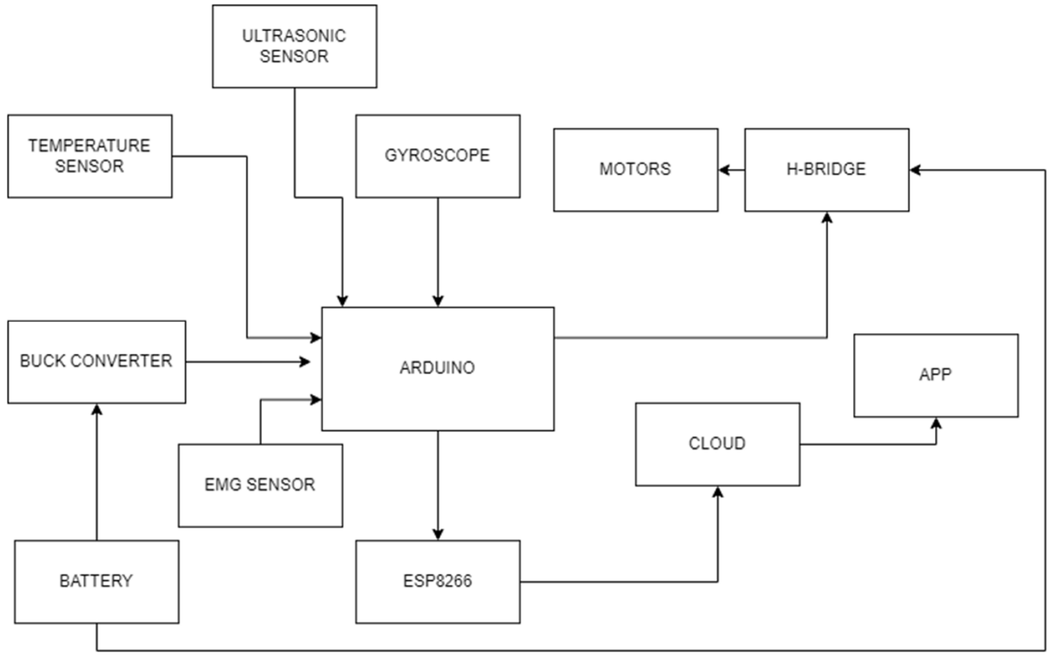

FIG.1 BLOCK DIAGRAM

B. *Interfacing Arduino With Gyroscope*

The MPU6050sensor is a multi-functional chip. Because it features a 16bit analogue to digital converter for each channel, this module is exceptionally accurate when converting analogue information to digital. It includes a temperature sensor, a MEMS accelerometer, and a MEMS gyro. This module can simultaneously record the x, y, and z channels. To connect with the host controller, it has an I2C interface. Compact chip with an accelerometer and gyro, the MPU6050 module. For many applications, including drones, robotics, and motion sensors, this is a highly helpful item. It is also known as a triple-axis accelerometer or a gyroscope.

An 8-pin, 6-axis gyro and accelerometer are combined in the MPU-6050 chip. By default, this module uses I2C serial connection, however it may be set up with an SPI interface by changing its register. This has SDA and SCL lines for I2C. Although almost all the pins are multifunctional, we are only using the I2C mode pins in this instance. Four wires must be connected to your Arduino for it to work with a gyroscope sensor. Two wires are required to link the gyroscope's VCC pin to the Arduino's 5v pin and the gyroscope's Gnd pin to the ground (Gnd). The Arduino's two analogue inputs require the connection of an additional pair of wires. The first of these wires comes from the gyroscope's SCL pin, and the second wire comes from its SDA pin.

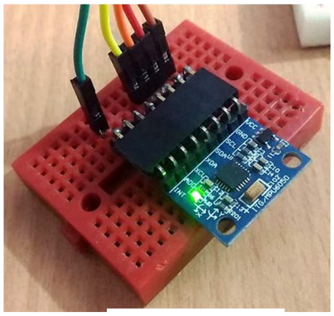

Fig.2 Gyroscope

C. *Interfacing Arduino With Electromyography Sensor*

The 3-lead differential muscle/EMG sensor was the EMG tool employed in this experiment. It has a built-in 3.5mm cable port where standard EMG/ECG electrodes can be connected. Two sets of pins are present on the sensor board: a 3-pin set that consists of -+Vs, GND, and -Vs terminals. It is employed to supply the AD8226 amplifier with a dual supply. A pair of two-pin connectors with signal and GND terminals. It is utilized as the board's interface with the microcontroller.

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Connect one battery's positive terminal to the +VS pin. Then join the positive terminal of the second battery to the GND pin on the 3-pin header by connecting the negative terminal of the first battery to both batteries' positive terminals. Next, join the -Vs pin to the negative terminal of the second battery. The sensor receives the +/-9V dual supply from this. The Ground pin in the 2-pin header should be connected to one of the two ground pins on the Arduino UNO in order to communicate with it. The signal pin should then be connected to any analogue input pin, such as A1.

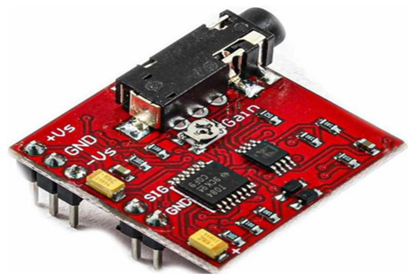

Fig.3 Electromyography Sensor

D. Interfacing Arduino With Dht11

It is quite simple to add humidity and temperature data to your DIY electronics projects when using the DHT11 humidity and temperature sensor. It is ideal for outdoor weather stations, indoor climate management systems, and farm or garden monitoring systems. Relative humidity is measured via the DHT11. The difference between the amount of water vapour in the air and its saturation point is known as relative humidity. Water vapour begins to condense at the saturation point and builds up on surfaces to form dew. As the air temperature fluctuates, so does the saturation point. Hot air can contain more water vapour before it becomes saturated, whereas cold air can hold less before it does. Relative humidity is expressed as a percentage. At 100% RH, condensation occurs, and at 0% RH, the air is completely dry. The data is transmitted to the Arduino by DHT11 using just one signal cable. Ground and 5V are supplied by independent cables. A 10K Ohm pull-up resistor is needed between the signal line and the 5V line in order to guarantee that the signal level remains high by default.The DHT11's VCC pin connects to the Arduino's +3V supply. The DHT11's DATA pin connects to the UNO's Analog Pin A0. The Ground Pin of the UNO is connected to GND Pin of the DHT11 (GND).

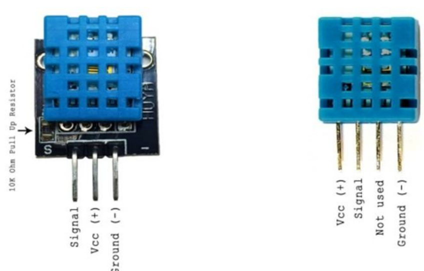

Fig. 4 DHT11 Sensor

E. Interfacing Arduino With Esp8266

A low-cost standalone wireless transceiver that can be utilised for end-point Internet of Things advancements is the ESP8266 WIFI module. Applications for embedded devices can connect to the internet using the ESP8266 WIFI module. It connects to the server or client using the TCP/UDP communication protocol. Connect the Arduino Uno's TX to the ESP8266's TX.RX on the Arduino Uno should be connected to RX on the ESP8266. Connect the ESP8266's EN pin to the Arduino Uno's 3.3V. Attach the ESP8266's 3v3 (or VCC) to the Arduino Uno's 3.3V. GND on the Arduino Uno should be connected to GND on the ESP8266.

Fig. 5 ESP8266

IV. CONCLUSION

Smart walkers constitute a significant research area as there is an increased demand in age related issues. Physical therapy sessions can be remotely monitored utilizing Internet connectivity and mobile applications by implementing physical rehabilitation assessment networks based on smart walker nodes that measure force, acceleration, and motion. The applications may also enable the client-server architecture-based storage and processing of sensor data. The findings made it abundantly evident that the suggested technologies can significantly improve the quality of life of walkers by detecting unbalance and instability**.**

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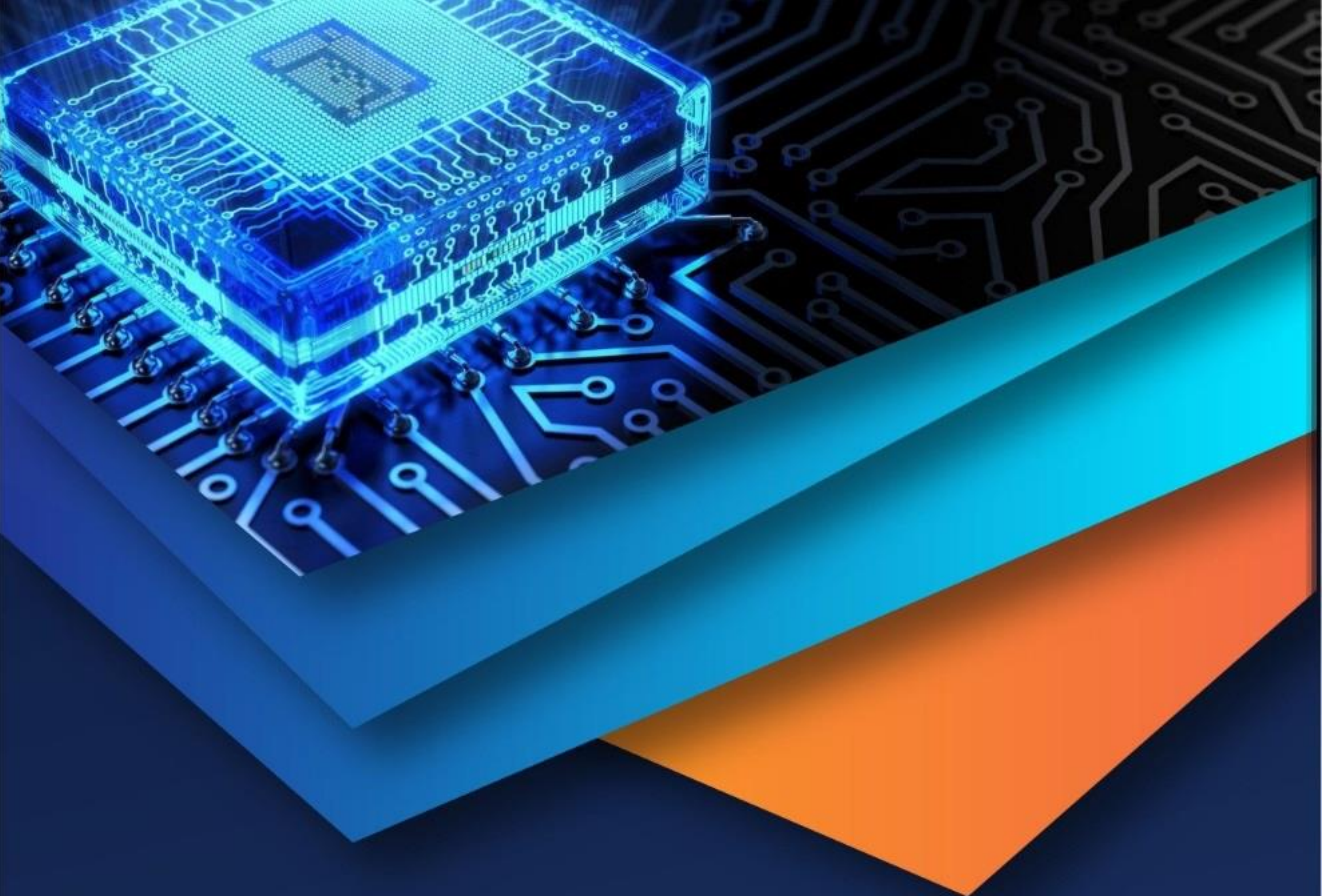

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