L.E.D (LifeFone for Elderly and Disabled)

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Abstract - *Constant movement has always been an important part of human life, which does not seem like much of a hurdle for people having no disability but a significant percentage of our global population consists of old people and people with disability. Many people today suffer from paralysis, physical illness, injury or any other disability. They also might have walking difficulties. Hence, to help these people overcome their day-to-day issues and dependency on other family members, we want to combine two essentially developing devices in the field of science – Fall Detection System - which uses accelerometer and gyroscope to detect a human fall accurately along with IFTTT API integration to get an instantSMS and Hand Gesture based Wheelchair System - which uses Arduino Mega, Arduino Nano, NODE MCU, MPU 6050 Gyro sensor, GSM Module, HC-05 Bluetooth Module, nRF Transceiver, and relay-based H-Bridge Motor Driver Circuits to design the wheelchair prototype. L.E.D (LifeFone for Elderly and Disabled) is a combined device that would help elder as well as disabled people navigate their day-to-day life with the least amount of difficulties.*

Key Words: **Arduino, GSM Module, Gyro sensor, nRF Transceiver, IFTTT API,**

1. INTRODUCTION

In the past few years, the development in the field of fall detection system along with hand-gestured wheelchair has become a widely researched topic. Currently, a lot of assistive and guidance systems are available out there in the market. These systems make for a more comfortable navigation for the physically disabled person. The systems which are being developed are exceptionally competitive in replacing the old traditional systems. Though manual wheelchairs and help have turned out to be valuable for the debilitated, it has just filled the need of individuals with minor inabilities. Hence, we have divided the system in two sections:

(I) Hand gestured wheelchair system and

(II) Wearable device-based fall detection system.

A significant amount of people in the world today are sufferingfrom paralysis, physical illness, injury or any other disability. They might have walking difficulties also. A control system is developed with the aid of hand motion recognition for a physically handicapped person with his gesture movement.

A wheelchair (WC) is a power chair that is used while walking due to sickness, injury or impairment becoming difficult or impossible. Wheelchairs come through a wide range of designs to match their users' unique needs. This wheelchair can be operated by hand movements. It has an accelerometer sensor which controls the person's hand motion of the moving stools and clarifies the person's movement andmoves accordingly.

When we change the ways, the sensor registers values also changes and those values are given to the atmega328p controller. Arduino controller controls the wheelchair ways like Left, Right, Forward, and Backward. This depends on the direction of the acceleration. Also, this program has the function of introducing control of Wheelchair direction reorganization of the hand gesture. The proposed wheelchair is used for many applications including schools, hospitals, old homes and airports.

Wearable device-based systems are worn by the user to detect falls. An integration of both gyroscope and accelerometer that can measure the acceleration and angular velocity is used in both the devices. Themovement and activity of the user result in a temporary variation of the noted acceleration and angular velocity data, leaving different prints for different activities. It is possible to determine the type of activity performed by the user by analyzing the measured angular velocity data and acceleration. Multiple studies have investigated the performance of wearable device-based systems.

The biggest advantage of wearable device-based fall detection system is that can recognize human activity without hindering any user privacy. Widely used smartphones with built-in accelerometers and gyroscopes can also be used to measure the acceleration and angular velocity as the user moves around and performs different activities. The falls can be detected by analyzing the measured data in real time. This fall detection approach is very attractive because it requires no new equipment and is therefore cost-effective. Altogether after combining these two we get an effective mechanism for the physically disabled or elderly person. This can also be used for someone who is elder but not disabled or both. In addition, the SMS will be sent to the guardians in case of emergency by pressing a single switch.

2. LITERATURE SURVEY

A lot of time and resources can be saved and it can be redirected to develop more innovative ideas instead of repeating the same or existing searches.

2.1 Fall Detection

Various papers were taken into research, like the system proposed by Wala, Altaf, Adnan consists of two modes of operation: 1) fast mode for fall prediction (FMFP) predicting a fall event (300 msec-700 msec) before occurring, 2) slow mode for fall detection (SMFD) with a 1-sec latency for detecting a fall event. A nonlinear Support Vector Machine Classifier (NLSVM) - based FMFP algorithm is used which extracts 7 discriminating features for the pre-fall case to identify a fall risk event and alarm the patient. FMFP achieves sensitivity and specificity of 97.8% and 99.1%, respectively, while SMFD achieves sensitivity and specificity of 98.6% and 99.3%, respectively, for a total number of 600 measured falls and ADL cases from 77 subjects[1].

2.2 Hand-Gesture Controlled Wheelchair

The paper by Abu Tayab Noman et al. presents the ideology to create a cost-effective electronic gesture-based wheelchair which will be easy to operate rather than the joystick input to control a wheelchair using the in-built gesture function of a touch sensor and smartphone. This wheelchair uses ATMega328 as a processor along with the L298N motor driver,DC Gear Motor, Ultrasonic Sensor, TTP224 Capacitive Touch Sensor, Bluetooth Module and IP Camera.

Design and implementation of a low-cost hand gesture controlled automated wheelchair-using Arduino based microcontroller and Node MCU is presented in the paper written by Mufrath Mahmood et al.This paper focuses majorly on how to control a wheelchair by using the hand-wrist movement and which can also be controlled via Bluetooth technology. The Bluetooth technology acts a fail-safe method in case of any problem and can also be used by the caregiver assisting the person in need. The design also has some additional features such as tracking the location of the wheelchair through GPS from anywhere in the world and emergency switching system to send messages to the assisting person through sensor-based network. Arduino Mega, Arduino Nano, NODE MCU, MPU 6050 Gyro sensor, Sonar Sensor, GPS Module, GSM Module, HC-05 Bluetooth Module, nRF Transceiver, and relay-based H-Bridge Motor Driver Circuits are used to design the wheelchair prototype.

P. Upender et al. present a new and innovative way of gaining control of a wheelchair. This wheelchair can be operated by both quick joystick and hand movements. This prototype consists of an accelerometer sensor that controls the user's hand movements and clarifies user movement before moving accordingly. ATMega328P controller is given the values that are changed and registered at the sensors. Depending on the direction of the acceleration, the Arduino controller controls the wheelchair ways like Left, Right, Forward, & Backward. This system also consists of ultrasonic sensors for obstacle avoidance.

3. DESIGN AND IMPLEMENTATION

3.1 Fall Detection

Our device is based on the algorithm that during a fall, a person experiences a Freefall or we can say reduction in acceleration, which is then followed by a huge spike in acceleration, and then a change in orientation as well. This algorithm checks to see if the acceleration magnitude (AM) breaks aset lower threshold. The algorithm checks to see if AM breaks a set of upper threshold within 0.5s if this considered lower threshold breaks, then the algorithm checks to see if the person's orientation has changedin a set range within 0.5s and if the considered upper threshold breaks, it would indicate that a person has fallen or toppled. Now if the person's orientation has changed, the algorithm then goes on to examine and see if that orientation remains the same even after 10s, which would indicate that the person is immobilized in their fallen position on the floor. If this holds true, then the algorithm declares this as a fall and an immediate text will be sent to the concerned guardian.

According to the algorithm, a program was developed for collecting data. 6DOF MPU6050 accelerometer & gyroscope sensor is being used. This sensor provides data through the I2C serial bus. Arduino wire library is being used to connect with the sensors using ATmega328 microcontroller. We use standalone ATmega chips instead of Arduino boards to keep the form factor tiny because form factor is a major issue for wearable devices to deal with. MCU is a wifi chip plus a programmable microcontroller. Before we start programming, weneed to flash our ESP-01 with the latest NodeMCU firmware. Oncewe have uploaded the latest NodeMCU firmware. All we need is to upload init.lua, button.lua and ifttt.lua.

LuaLoader is a Windows program for uploading various files to the ESP8266 and working with the Lua serial interface as well as being the simplest terminal program, it has built-in Lua command buttons which makes it easy to experiment and interact with the ESP8266 board. LuaLoader.exe is a simple Windows application that does not require special installation. We can go to the the Settings menu, and select COM Port Settings and choose the appropriate COM port for our USB to serial adapter. We don't need to change any other setting. Clicking buttons on LuaLoader will send commands to the board. And now you can power your board and see the initial message. LuaLoader will give you a warning if a firmware build is available later. After booting it, the NodeMCU will attempt to run a file called init.lua in flash memory. As we haven't put anything in there, it will report an error and show the > prompt. You are now ready to interact with Lua on the ESP8266. Click the Heap button to display the amount of RAM available. LuaLoader will type the command = node.heap() and the ESP8266 will respond with 23016 or some other value, followed by the > prompt again. Once we are done with the set up, we are good to go and run the program.

Fig-1: Architectural layer diagram of the system

In the above diagram we are using a structure that can be divided into four layers, namely Local Communication Layer (LCL), Physiological Sensing Layer (PSL), User application Layer (UAL) and Information Processing Layer (IPL). Here the PSL is the fundamental layer which has different sensors which is used to collect physiological and ambient data from the human being monitored. LCL is the layer responsible for sending the signals to the above layers for further processing and analysis. This layer might have both wireless and wired methods of transmission, connected to cloud computing platforms or to local computing facilities. Local Communication Layer typically takes the form of one or more than one communication protocols, including wireless mediums such as ZigBee, Bluetooth, Wi-Fi, or even wired connections. IPL is a major component of the system. It includes hardware as well as software components, such as micro-controller, to analyse and transfer data from PSL to the above higher layers. UAL is concerned with applications that assist users. For example, if a fall is detected in the IPL, a notification is initially sent to the user and then if the user confirms the fall or does not answer back, an alarm is sent to the emergency caregiver who is expected to take appropriate actions.

3.2 Hand-Gesture Controlled Wheelchair

In this design the wheelchair is divided into two major sections, one is the wheelchair and the other is the control section for gesture control. For hand acceleration in three perpendicular directions a MEMS accelerometer is detected and is transmitted to a PC via Bluetooth. The data of speed is given to the framework by the situation of the palms itself.

The hand motions are composed in a chain of command considering the ergonomics, unwavering quality of ID and the method of activity. The outcomes introduced show the conduct of the wheelchair in light of manual and guide mode hand signal orders. The framework has been put to test by people of various hand shapes and end up being amazingly solid.[5] in this proposed design power of movement in the WCis split into 2 parts:

1. Controller: Hand transfer

2. Receiver: the WC.

The unit of gesture consists of LPC2138, three flex sensors, andone glove-mounted accelerometer sensor, and XBeeS1. The wheelchair assembly is composed of LPC2138, L293DNE driver.

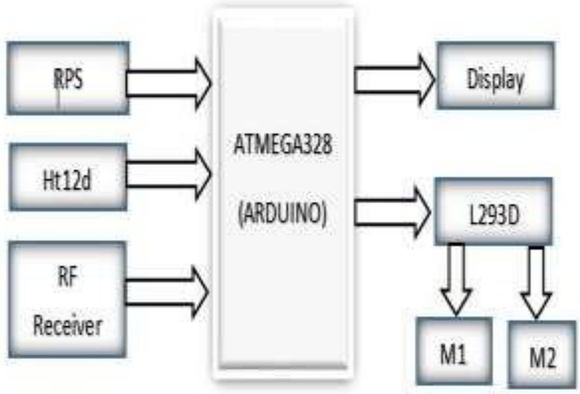

Fig-2: Block diagram of the receiver

It requires both hands to reorganize the hand movement. Individuals need to be able to track the chair in limited space, asthis setup uses IR sensors that are also useful for object avoidance. In addition, the SMS will be sent to the guardians.

The block diagram is depicted in fig 2. Arduino (ATMEGA328P), LCD display, accelerometer, transceiver are the major components of this system. The actual control section is depicted in fig.3 where the RPS and accelerometer are connected to the Arduino itself. Proposed work uses Atmega3289, Lcd, Sensor, L293d, Hti2d, Regulated Power Supply, Ht12e, Accelometer.

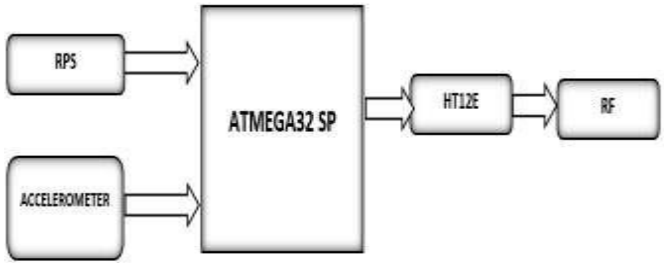

Fig-3: Block diagram of control system

This hand gesture controlled wheelchair uses an ADXL335 accelerometer as a detector which can provide an analogue signal on pushing the wheelchair in the X, Y orientation respectively. To transform this analogue signal into a digital signal an operation amplifier LM324 is used as a comparator.

A radio frequency transmitter is used for wireless signal transmission. The data is encoded before sending to avoid issues from different computers. This will also eliminate interference and undesirable noise. The detector now sends the message and is then interpreted by the controller so that the signal is decoded further by sending the receiver to Arduino Uno for data.

The wheelchair will move when the signal is received and the L293D gives the relay signal. A simple wheelchair control scheme based on the user's right arm's understanding of hand movements is developed. The controller puts his right hand in his/ her hand motion circuit to operate in gesture recognition mode. As per directions the user performs the gesture. The wheelchair is powered by electric motors during gesture recognition mode.

When the arm is in a neutral position the motor does not function and the wheelchair is in a halted position. By shifting their hand from the relaxed position the user provides the direction for the wheelchair to move. Extending the hand beyond the neutral position causes wheelchair motion, while trying to bend the arm closer to the body causes the bend backwards. This makes it easy to control the direction of the wheelchair by changing the user hand's position. Once the person adds his hand to the stable position, the wheelchair halts.

Movement of wheel chair	Threshold angle of hand gesture
Forward	25 degrees forward
Backward	25 Degrees backward
Stop	0 degree
Left	30 Degree left
Right	30 Degree right

Fig-4: Angles details

Fig. 5 depicts the flowchart of the transmitter. It first checks the motion of the accelerator upon which will be given to the encoderfor processing this signal.

Then it is given from the transmitter to the receiver section depicted in fig 6. Which takes the analog input and process that to the decoder and microcontroller and the motor drivers. Depending on the accelerometer signal motor will move towards left/right orforward/backward.

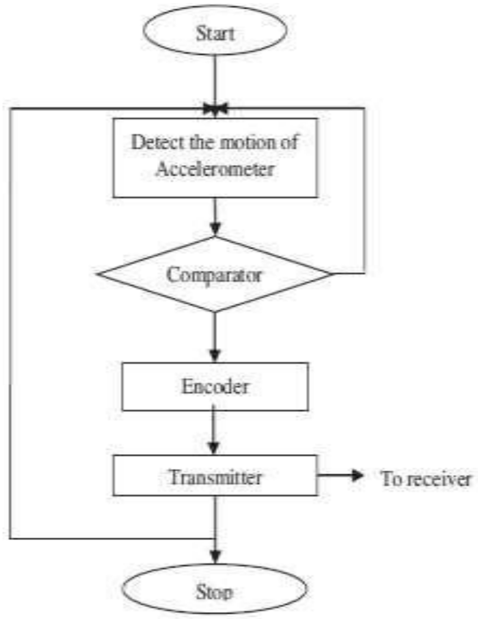

Fig-5: Flowchart for transmitter process

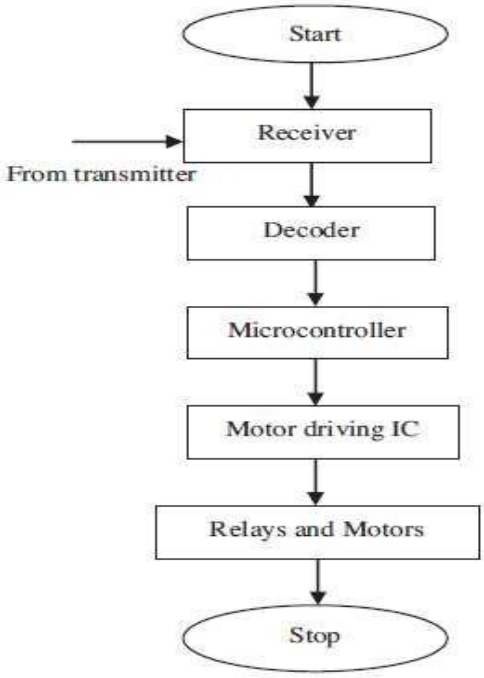

Fig-6: Flowchart for receiver process

3. CONCLUSIONS

This project involves the accomplishment of the task using a fall detection and hand gestured wheelchair. Exchange of frame between accelerometer and gyroscope and hand movement sensors enables the device to execute the given task.

In this paper, we have seen that with increasing development in technology, the complexities and constraints based on applications are also increasing. The developed system is capable of controlling the wheelchair motion for disabled people using hand gestures and detecting falls successfully. By using various body gestures such as eye gaze, leg movement or head movement accordingly we can make a lot of improvements.

The switching operation for the mode selection that is either touch pad or accelerometer is separated by using a switch. Thisadds up to the efficiency of the wheelchair and reduces the cost and size of the entire system. The proposed L.E.D can be used in many applications such as hospitals, old age homes and airports etc. In future, 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 to enhance the speed and estimate the delay for action to be taken to enhance the speed of the wheelchair dc motors can be replaced by servo motors.

ACKNOWLEDGEMENT

Foremost, we would like to express our sincere gratitude to Professor Dr Nema Shikha, Head of Department (Electronics) and our guide and also Mrs. Arundhati Mehendale for their valuable guidance and continuous support through her patience, motivation, enthusiasm, and immense knowledge. We would also like to thank all the teaching and non-teaching staff for their valuable support. Last but not least we would like to thank our parents and friends.

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BIOGRAPHIES

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