SMART WEARABLE DEVICE FOR ELDERLY CARE SAFETY USING IOT

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***Abstract*—** The aim is to build an elderly monitoring system using IOT and to set up safety and service platform for elderly care. It is useful at times when there is no one nearby to look after the elderly people or when everyone is out to their work. This will greatly help families of elderly person to keep track of their loved elder ones and provide care for their wellness by reminding about their health information. An android application is also integrated with the device to list out the monitored data in organized manner. The firebase which is implemented using Cloud technology has been used to store health information of them and only the admin has the access to such data and the family members can take a look on request by logging into the application using proper credentials.

Keywords*—Internet* of Things (IoT) , Elderly Health Monitoring , Cloud Computing , Android Application , Firebase.

I. INTRODUCTION

It may seem that for elders to stay at home is the safest place for them to avoid health hazards. But one of the few problems faced by elderly people is the tendency for them to lose conscious or fall ill even when they are at home. Our approach is the capability to monitor elderly people at their convenience usually preferred as homes. Elderly care also as aged care, serves the needs and requirements of elderly people. IOT solutions are excellent for managing health as seniors suffering from this disease. IoT refers to Internet of Things (IoT). Connecting any device (including anything like cell phones, vehicles, home appliances and other wearable embedded with sensors and actuators) with Internet so that these objects can exchange data with each other on a network. It is fascinating to note that there is a difference between IoT and the Internet; it is the absence of human interaction. The IoT devices can create information about individual's behaviors, analyze it, and take action that infers IoT is smarter than Internet.

II. LITERATURE SURVEY

A. *IoT Wearable Devices for Elderly Care*

Authors: Thanos G. Stavropoulos, Asterios Papastergiou, Lampros Mpaltadoros, Spiros Nikolopoulos, and Ioannis Kompatsiaris

The increasing ageing global population is causing an upsurge in healing elements related to old age, primarily dementia and Alzheimer's disease, frailty, Parkinson's, and cardiovascular disease, but also a general need for personal eldercare as well as active and healthy ageing. In turn, there is a strong need for constant monitoring and assistance, intervention, and support, causing a considerable financial and human burden on individuals and their caregivers. Interconnected sensing technology, such as IoT wearables and devices, present a consistent solution for objective, motive, reliable, and remote monitoring, assessment, and support through ambient assisted living in future.

B. *Elderly People Care via Unusual Behavior Detection: A Disaster Management Approach using IoT and Intelligence.*

Authors : Prateek Pandey, Ratnesh Litoriya

This paper attempts to provide a minimal disaster mitigation framework for the elderly who are living alone. Elderly people are generally more vulnerable to hazards and emergency situations. The proposed framework visions at developing an IoT based intelligent, protective

ecosystem for elderly that calls for help in emergencies like tsunami, flood, earthquake, home fire, volcanic eruption, and storms. This disaster system makes use of a wide range of calamity sensors in conjunction within household activities of the elderly subject. In the case of mishappening, the disaster relief authorities, community members, and other stakeholders will be informed immediately.

C. *Using IoT Assistive Technologies for Elder People Non-Invasive Monitoring and Living Support in Their Homes .*

Authors : Sorin-Aurel Moraru , Adrian Alexandru Mos, oi , Dominic Mircea Kristaly , Liviu Marian Perniu , Dan Rosenberg, Ionut, Moraru , Vlad S, tefan Petre , Delia Elisabeta Ungureanu , and Maria Elena Cocuz

Many western societies are confronted with issues in planning and adapting their health policies due to ageing population left deserted. The "Not Alone at Home NOAH" project aimed to involve older people in the Agile cocreation of services for an instant collaborative monitoring and awareness notification for remote caregivers. The aim was to create a scalable and modern information system that permitted a non-invasive monitorization of the users for keeping their caregivers up to date. This was done through a cloud IoT, which collects and processes data from its domotic sensors.

D. ***Elderly Fall Detection Systems***

Authors:Xueyi Wang, Joshua Ellul and George Azzopardi

The elderly people often tend to fall due to weakness. With the rise in population this problem has been boomed onto next level. Due to Technology development this problem is addressed in a effective manner by the internet of things and other sensors. This paper is relavent to this problem of elderly fall and addressed this issue. Even though there are many researches regarding this issue with the help of depth cameras and sensors mostly the alarm is invalid. This paper is focused on more accuracy and less false alarms providing higher resolution to the invention. This paper provides the solution from the different perspective including various data collection, integration, data fusion, and providing security and privacy.

E.***Internet of things (IoT) applications for elderly care.***

Authors : Soe Ye Yint Tun, Samaneh Madanian,Farhaan Mirza

Increase in elderly population put extra pressure on healthcare systems globally in terms of both operational costs and resources. To minimize this pressure and provide efficient healthcare services, the application of Internet of Things and wearable technology could be convincing. These technologies have the potential to enhance the quality of life of the elderly population while reducing pressure on healthcare systems and minimizing their operational cost. Eventhough IoT and wearable applications for elderly healthcare purposes were reviewed previously, there is a further need to summarize their current applications in this fast growing area. This paper provides a comprehensive overview of IoT and wearable technologies applications including the types of data collected and the various types of devices for elderly healthcare. This paper provides insights on both existing areas of IoT/wearable applications and also presenting new research opportunities in evolving areas of applications, such as robotic technology and integrated applications.

III. PROPOSED SOLUTION

The system which we propose collects patient's data's like heart rate, oxygen level and body temperature using MAX30105. A patient's location and position is monitored using android application and accelerometer. A smart device for elderly safety which automates the emergency alert system by using heart rate sensor to detect a possible emergency automatically using outlier detection is proposed. The abnormal activity is calculated in the application. If emergency situation arises an alert goes to relatives.

IV. IMPLEMENTATION

The MAX30105 is a complete pulse oximeter and heart-rate sensor system solution module designed for the demanding requirements of wearable devices. The device manages a very small solution size without sacrificing in optical or electrical performance. Only small amount of components required for wearable system. The MAX30105 is fully adaptable with the help of software registers. The data is stored as FIFO manner. The data is not continuously read as the microprocessors is shared on a common bus.

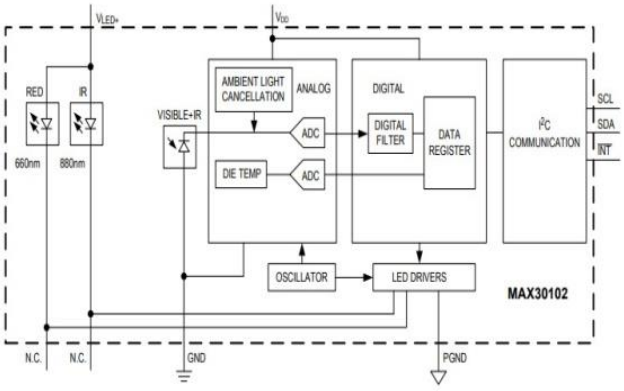

Fig 1. Functional Block Diagram

SpO2 of MAX30105 consists of ambient light cancellation (ALC) and a time filter which is discrete in nature. The ALC has an ambient light canceller to increase the dynamic range. The ALC can cut up to 200µA of ambient current. The internal ADC is a 18 bit resolution converter which is continuous. The ADC sampling rate is 10.24MHz. The ADC output data rate can be programmed from 50sps to 3200sps.

The temperature dependence of the SpO2 sub-

system is calibrated using an on-chip temperature sensor in MAX30105. The temperature sensor has an inherent resolution. The output date is insensitive to IR wavelength whereas RED led is very crucial for determining correct data. A SpO2 algorithm used with the MAX30105 output signal can compensate for the associated SpO2 error with ambient temperature changes.

The Red and IR LED drivers are integrated by MAX30105 to modulate LED pulses for SpO2 and HR measurements. The LED current can be programmed from 0 to 50mA with proper power supply voltage. The LED pulse width can be programmed to optimize SpO2 based on use cases.

Acceleration is measured in units of gravitational force or "G", where G represents the gravitational pull at the surface of the earth. Gravity is a convenient force for surface earthlings. The sensor is fixed in the box. The size is not considered, as long as all the sides are at right angles. The material is not considered as long as it is fairly rigid. The ADXL345 is a low-power, 3-axis MEMS accelerometer module with both SPI and I2C interfaces.

The boards which are known as Adafruit helps to onboard 3.3V voltage and shifts leveling. This makes the modules simple and helps to interface with 5V voltage microcontrollers. These microcontrollers include Arduino. The ADXL345 sensitivity range is from +/-2G to +/-16G.

The structure of the sensor is micro machined structure on the silicon water. The poly silicon springs are used to suspend the structure which allow it to deflect smoothly in any direction when it is subjected to acceleration in the X, Y and/or Z axis. Deflection creates a change in capacitance between fixed plates and plates that are attached to the suspended structure. This change in capacitance is converted to an output voltage proportional to the specified acceleration.

The ESP32 is the design for low power IoT applications in mind. It has high processing power with in-built Wi-Fi or Bluetooth and Deep Sleep Operating capabilities makes it ideal for the most Portable IoT devices. Since Arduino IDE has released board managers for ESP32 officially and hence it has become completely easy to program ESP32 devices.

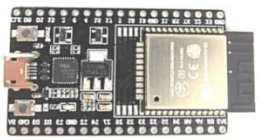

Fig 2 . ESP32 DevKit

There are total three ways by which you can power your ESP32 board-

Micro USB Jack: Connect the mini USB jack to your phone charger or computer through a cable and it will draw power required for the board to function.

5V Pin: Generally ESP32 is regulated using 3.3V but 5V pin can also be supplied with 5V. This 5V voltage can also be regulated to 3.3V for the use of ESP32.

3.3V Pin: If you have a regulated 3.3V supply, then you can directly connect this to the 3.3V pin of the ESP32.

Input/output

ESP32 contains 39 digital pins for Input/Output. Out of 39 digital pins 34 pins are used as GPIO. The balance 5 digital pins can be used for input purpose only. ESP32 has 18 channels for 12bit ADC and has 2 channels for 8Bit DAC. The device also contains 16 channels for PWM signal generation and GPIO pins are supported by 10 channels. The ESP32 has multiplexing feature, this enables the programmer to configure any GPIO pin for PWM or other serial communication through programESP32 also supports Interface such as 3 UART interface, 3 SPI interface, 212S interface, 212C interface and also CAN protocol.

- **3 UART interface: 3 UART interface for TTL communication has been supported by ESP32.** The 3 UART interface requires 3 sets of Tx and Rx pins. Any GPIO pin can be used for UART since all the 6 pins are software configurable.
- **External Interrupt:** Any GPIO pin can be programmed to be used as an interrupt pin, since the ESP32 supports multiplexing
- **GPIO23 (MOSI), GPIO19(MISO), GPIO18(CLK) and GPIO5 (CS):** These pins are used for SPI communication. This is the first pin and supports two SPI.
- **GPIO13 (MOSI), GPIO12(MISO), GPIO14(CLK) and GPIO15 (CS):** SPI communication is performed with these pins. This is the second pin and supports two SPI.
- **GPIO21(SDA), GPIO22(SCL):** Used for IIC communication using Wire library.
- **Reset Pin:** Making the rest pin LOW resets the microcontroller. And hence the reset pin for ESP32 is the Enable (EN) pin.

How to use ESP32

The ESP-IDF is the native platform for programming ESP32. Arduino IDE is easy to use and hence most of the engineers use Arduino IDE. Espressif itself is the started guide available in official website for working with native platform.

You can upload your first program to ESP32 within 5-10 minutes using Arduino IDE. All you need the Arduino IDE, an USB cable, and ESP32 board it.

Uploading your first program

After installing Arduino IDE on the computer , the board should be connected with computer with the help of USB cable. After that correct board should be chosen by opening Arduino IDE which can be done by selecting **Tools > Boards > ESP32 Dev kit and correct port can be chosen by selecting Tools > Port**. Initially load the example code to get it started with ESP32 board. The example code can loaded by selecting **Files > Examples > Basics > Blink**. After uploading the example code to IDE, click on upload button from the top bar. The ESP32 built-in LED starts blinking once the upload is finished.

ADVANTAGES

- The device is portable and easy to use.
- It improves rise in elderly personal care.
- It provides access to the elder's dear one to look at their medical condition at critical time.

V. CONCLUSION

Nowadays, one of the biggest decisions many families are faced with is how to care for elders when those elders are no longer able to live independently. There are multiple different strategies for handling care for elderly people by their families. For figuring out the strategies for elder care, numerous factors should be taken into an account including fulfilling elder needs, allocating care for elder need, addressing the needs and managing legal and financial considerations associated with care arrangements. Once the appropriate care is located, the families should take care, help and support elder people and themselves throughout the transitioning and stressful process.The transitions of Eldercare will be very emotional and takes a large amount of time. Each stage should be given careful attention of the eldercare search and resource research process. It can help all the affected people to take confident decisions and arrangements they ultimately arrive at representing the best possible solutions.

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