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AIOT based Old Age Support System

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Abstract-*Improvements in life expectancy achieved by technological advancements in the recent decades have increased the proportion of elderly people. Frailty of old age, susceptibility to diseases, and impairments are inevitable issues that these senior adults need to deal with in daily life. Recently, there has been an increasing demand on developing elderly care services utilizing novel technologies, with the aim of providing independent living. Internet of things (IoT), as an advanced paradigm to connect physical and virtual things for enhanced services, has been introduced that can provide significant improvements in remote elderly monitoring. Several efforts have been recently devoted to address elderly care requirements utilizing IoT-based systems. Nevertheless, there still exists a lack of user- centered study from an all-inclusive perspective for investigating the daily needs of senior adults. IoT- enabled systems tackling elderly monitoring to categorize the existing approaches from a new perspective and to introduce a hierarchical model for old-age support. We investigate the existing approaches by considering the elderly requirements at the center of the attention. In addition, we evaluate the main objectives and trends in IoT-based elderly monitoring systems in order to pave the way for future systems to improve the quality of elderly'slife.*

Keywords:*old age, GSM, sensor, Arduino, safety*

I. INTRODUCTION

Senior adults require more attention and care as a minor accident or an insignificant disease may cause irreparable damages. It should be also considered that many senior adults may live alone whereas it is necessary to be monitored or assisted by caregivers or medical experts. Therefore, there exists an increasing demand for developing novel technologies to provide efficient remote elderly monitoring services. To this end, various moderndisciplines should be utilized to address the elderly requirements considering their limitations in daily life. Internet of things (IoT) as a promising paradigm can provide such essential services for elderly adults. IoT is an advanced technology exploiting various disciplines such as sensor development, data acquisition, communication and networking, data management and data processing, etc. where things (e.g., objects, people) with unique identities are able to connect to a remote server and also to form localnetworks.

II. PROBLEMSTATEMENT

Older age is associated with many changes to the body whether it be due to the aging process or the developmentof diseases commonly seen in older adults. The body is impacted across a variety of systems, from the muscular, skeletal, and nervous systems, to changes in sensation, coordination, vision, and auditory processes. As a result of these changes, an individual's independence and ability to perform activities of daily living (ADLs) may be greatly impacted. Some older adults have difficulties with hand function, which has been demonstrated to decline steadily after 65 years of age. The older population presents with a variety of declines in hand function: hand and finger strength,precisiondexterity,tactilesensation,voluntaryfine motor control, and bimanual coordination, to name a few. It is important to note that difficulties in vision, such as color differentiation, depth perception, and hand-eye coordination, will also affect hand performance. It aims to reducethenecessityoftheseskills,allthewhilemaintaining safety, reducing falls risk, and being aesthetically pleasing forconsumers.

III. MERIT OFPROJECT

With advancing age, people often lose motor functions. Performing day to day activities becomes a daunting task. In an old age home, the association helps withdaily activities. An alternative to this is having a dedicated caregiver who can help with the everyday chores around the house. Through this

project we can increase the age expectancy of older people and they can be self-dependent. Using infrared sensor, we can detect their body movement and gestures so that the daily life will be easy. Safety is definitely an issue for senior citizens. The steady security in an old age home gives them protection from intruders and helps them live asafe and securelife.

IV. TECHNOLOGYUSED

1) ComponentDescription

a) PIR Motion DetectionSensor

Passive Infra-Red or PIR Sensor is a Pyroelectric device that detects motion. Hence, it is also called as motion detection sensor. It detects motion by sensing the changesin infrared levels emitted by nearbyobjects.

b) GSM Module (SIM 900A)

SIM 900A is the GSM/GPRS module with built in RS232 interface. It has dual band GSM/GPRS system that works on 900/1800MHz frequencies. With the help of RS232, the modem can be connected to PC or microcontroller via serial cable. Voice calls, SMS and internet access are possible with this module. There are on board connections for microphone and headphones with which we can make or receivecalls.

c) Arduino UNO

It is the main controller used in this project. It detects the signals from PIR sensor and sends commands to GSM Module accordingly. The serial pins of the Arduinoareused in this project to communicate with GSMmodule.

LEDs are also used to detect motion and proper functions of individual components.

A GSM Module is basically a GSM Modem (like SIM 900) connected to a PCB with different types of output taken from the board – say TTL Output (for Arduino, 8051 and other microcontrollers) and RS232 Output to interface directly with a PC (personal computer). The board will also have pins or provisions to attach mic and speaker, to take out +5V or other values of power and ground connections. These types of provisions vary with different modules.

d) Notes on GSMModule

1. We use SIM900 GSM Module – This means the module supports communication in 900MHz band. We are from India and most of the mobile network providers in this country operate in the 900Mhz band. If you are from another country, you have to check the mobile network band in your area. A majority of United State**s** mobile networks operate in 850Mhz band (the band is either 850Mhz or 1900Mhz**).** Canada operates primarily on 1900 Mhz band. Please read this wiki entry on GSM Frequency Bands around theWorld.
2. Check the power requirements of GSM module – GSM modules are manufactured by different companies. They all have different input power supply specs. You need to double check your GSM modules power requirements. In this tutorial, our gsm module requires a 12 volts input. So we feed it using a 12V,1A DC power supply. I have seen gsm modules which require 15 volts and some other types which needs only 5 volts input. They differ with manufacturers. If you are having a 5V module, you can power it directly from Arduino's 5Vout.

Note: - GSM Modules are manufactured by connecting a particular GSM modem to a PCB and then giving provisions for RS232 outputs, TTL outputs, Mic and Speaker interfacing provisions etc. The most popular modem under use is SIM 900 gsm modem from manufacturer SIMCom. They also manufacture GSM Modems in bands 850, 300 and other frequencybands.

3. Check for TTL Output Pins in the module – You canfeed the data from gsm module directly to Arduino only if the module is enabled with TTL output pins. Otherwise you have to convert the **RS232 data to TTL**using MAX232 IC and feed it to Arduino. Most of the gsm modules in market are equipped with TTL output pins. Just ensure you are buying the right one. So that's all about the gsm module basics. Now lets power itup!

e) Booting the GSMModule*!*

1. Insert the SIM card to GSM module and lockit.

2. Connect the adapter to GSM module and turn itON!

3. Now wait for some time (say 1 minute) and see the blinking rate of 'status LED' or 'network LED' (GSM module will take some time to establish connection with mobilenetwork)

4. Once the connection is established successfully, the status/network LED will blink continuously every 3 seconds.Youmaytrymakingacalltothemobilenumberof the sim card inside GSM module. If you hear a ring back, the gsm module has successfully established network connection.

Okay! Now let's see how to connect a gsm module to Arduino!

f) Connecting GSM Module toArduino

There are two ways of connecting GSM module to Arduino. In any case, the communication between Arduino and GSM module is serial. So, we are supposed to use serial pins of Arduino (Rx and Tx). So, if you are going with this method, you may connect the Tx pin of GSM module to Rx pin of Arduino and Rx pin of GSM module to Tx pin of Arduino. You read it right? **GSM Tx –>Arduino Rx** and **GSM Rx –>ArduinoTx**. Now connect the ground pin of Arduino to ground pin of gsm module! So that's all! You made 3 connections and the wiring is over! Now you can load different programs to communicate with gsm module and make it work.

Note: - The problem with this connection is that, while programming Arduino uses serial ports to load programfrom the Arduino IDE. If these pins are used in wiring, the program will not be loaded successfully to Arduino. So, you have to disconnect wiring in Rx and Tx each time you burn the program to Arduino. Once the program is loaded successfully, you can reconnect these pins and have the system working! To avoid this difficulty, we are using an alternate method in which two digital pins of Arduino are used for serial communication. We need to select two PWM enabled pins of Arduino for this method. So, I choose pins **9** and **10** (which are PWM enabled pins). This method is made possible with the **Software Serial Library** of Arduino. Software Serial is a library of Arduino which enables serial data communication through other digitalpins of Arduino. The library replicates hardware functions and handles the task of serialcommunication.

V. WORKINGOFARDUINOSECURITYALARM SYSTEM

Home Security Alarm Systems are very important inpresent day society, where crime is increasing. With the technological advancements we have achieved in the recent years, a homeowner doesn't have to worry about home security while getting off his/her home. Modern home security systems provide enough security from burglars, fire, smoke, etc. They also provide immediate notification to the homeowner. The aim of this project is to implement a simple and affordable, but efficient home security alarm system. The project is designed for detecting intruders and informing the owner by making a phone call. The working of the project is explained below. PIR sensor detects motion by sensing the difference in infrared or radiant heat levels emitted by surrounding objects. The output of the PIR sensor goes high when it detects any motion. The range of a typical PIR sensor is around 6 meters or about 30 feet. For proper operation of PIR sensor, it requires a warm up time of 20 to 60 seconds. This is required because, the PIR sensor has a settling time during which it calibrates its sensor according to the environment and stabilizes the infrared detector. During this time, there should be very little to no motion in front of the sensor. If the sensor is not given enough calibrating time, the output of the PIR sensor may not be reliable. When the PIR sensor detects any motion, the output of the sensor is high. This is detected by the Arduino. Arduino then communicates with the GSM module via serial communication to make a call to the preprogrammed mobile number. An important point to be noted about PIR sensors is that the output will be high when it detects motion. The output of the sensor goes low from time to time, even when there is motion which may mislead the microcontroller into considering that there is nomotion.

This issue must be dealt with in the programming of Arduino by ignoring the low output signals that have a shorter duration than a predefined time. This is done byassuming that the motion in front of PIR sensor is present continuously.

VI. MERIT OF THE PROJECT

With advancing age, people often lose motor functions. Performing day to day activities becomes a daunting task.In an old age home, the association helps with daily activities. An alternative to this is having a dedicated caregiver who can help with the everyday chores around the house. Through this project we can increase the age expectancy of older people and they can be self-dependent. Using infrared sensor, we can detect their body movement and gestures so that the daily life will be easy. Safety is definitely an issue for senior citizens. The steady security in an old age home gives them protection from intruders and helps them live a safe and secure life. Thanks to the developments in the medical science and related technologies, the world life expectancy index has been increased for the last decades and has been project edit further increase in the future (WHO 2014). Subsequently, the number of elderly people will grow with a rapid rate. Senior adults require more attention and care as a minor accident or an insignificant disease may cause irreparable damages (WHO/Europe 2015) [1]. It should be also considered that many senior adults may live alone whereas it is necessary to be monitored or assisted by caregivers or medical experts. Therefore, there exists an increasing demand for developing novel technologies to provide efficient remote elderly monitoringservices.

VII. USE OF ATCOMMANDS

AT commands are used to control MODEMs. AT is the abbreviation for Attention. These commands come from Hayes commands that were used by the Hayes smart modems. The Hayes commands started with AT to indicate the attention from the MODEM. The dial up and wireless MODEMs (devices that involve machine to machine communication) need AT commands to interact with a computer. These include the Hayes command set as a subset, along with other extended AT commands. AT commands with a GSM/GPRS MODEM or mobile phone can be used to access following information and services:

1. Information and configuration pertaining to mobile device or MODEM and SIMcard.
2. SMSservices.
3. MMSservices.
4. Faxservices.
5. Data and Voice link over mobile network.

Explanation of commonly used AT commands:

1) **AT** - This command is used to check communication between the module and the computer.
For example, AT
OK

The command returns a result code OK if the computer (serial port) and module are connected properly. If any of module or SIM is not working, it would return a result code ERROR.

2) **+CMGF** - This command is used to set the SMS mode. Either text or PDU mode can be selected by assigning 1 or0 in thecommand.
SYNTAX: AT+CMGF=<mode>
0: for PDU mode 1: for text mode

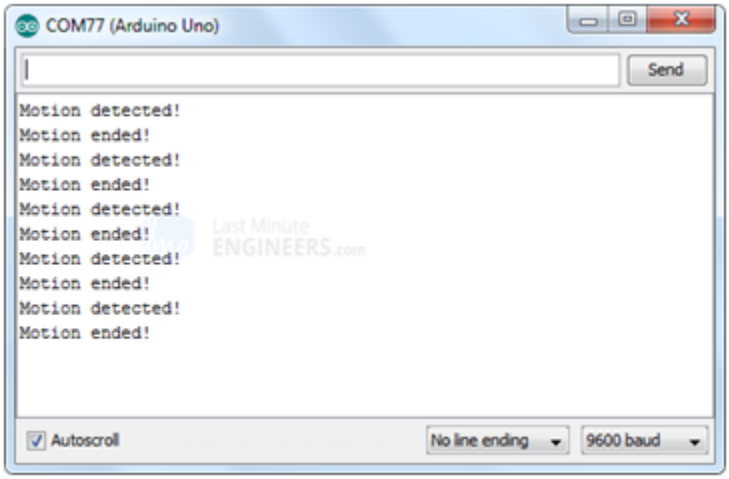
The text mode of SMS is easier to operate but it allows limited features of SMS. The PDU (protocol data unit) allows more access to SMS services but the operator requires bit level knowledge of TPDUs. The headers and body of SMS are accessed in hex format in PDU mode so it allows availing more features.

As ATA followed by enter key is pressed, incoming call is answered.
For example, RING
RING ATA

7) **ATH** - This command is used to disconnect remote user link with the GSM module.
SYNTAX: ATH(Enter)

VIII. OUTPUT

The LED glows for any motion that is detected and the serial monitor displays the below messages.



For example,

AT+CMGF=1 OK

3) **+CMGW** - This command is used to store message in theSIM.
SYNTAX: AT+CMGW=" Phone number"> Message to be stored Ctrl+z
As one types AT+CMGW and phone number, '>' sign appears on next line where one can type the message. Multiple line messages can be typed in this case. This is why the message is terminated by providing a 'Ctrl+z' combination. As Ctrl+zis pressed, the following information response is displayed on thescreen.

+CMGW: Number on which message has been stored

4) **+CMGS** - This command is used to send a SMS message to a phonenumber.
SYNTAX:AT+CMGS= serial number of messages to be send.

AsthecommandAT+CMGSandserialnumberofmessages are entered, SMS is sent to the particularSIM.
For example, AT+CMGS=1

5) **ATD** - This command is used to dial or call anumber. SYNTAX: ATD<Phonenumber>;(Enter)
For example, ATD123456789;

6) **ATA** - This command is used to answer a call. An incoming call is indicated by a message 'RING' which is repeated for every ring of the call. When the call ends 'NO CARRIER' is displayed on thescreen.
SYNTAX: ATA(Enter)

IX. ALGORITHM

The model has 2 working modes of operation.

Mode 1: When the elderly is at Home
1. PIR detects motion of the elderlyperson.
2. The Arduino gives command to the module to turn ON thebulb.
3. The Bulb glows based on the intensity of darkness inside the room making use of the LDR Sensorand continue to glow based on the user's thresholdtime requirement.
4. For different electrical appliances, there aredifferent PIR Sensors installed at appropriateplaces.

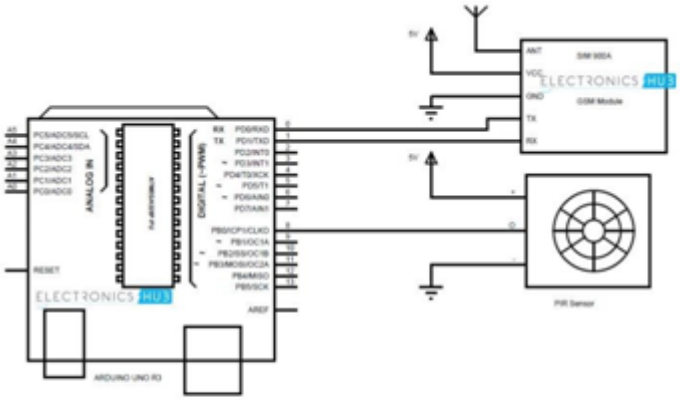
Mode 2: When there is no one at Home

1. PIR Detects Motion of anIntruder.
2. The Arduino gives command to the GSM Module GSM 900A making use of ATCommands.
3. There Is a call made to the number embedded in the code.

4. In case if someone does not receive the call, the module will look for other contacts in the sim and make thecall.

The model operational mode can be controlled by a switch or an RFID Card.

X. CIRCUITCONNECTION



RXofGSM ⟹ Pin 10 ofArduino
TX ofGSM ⟹ Pin 9 ofArduino
GND ofPIR ⟹ GND ofArduino
VCCofPIR ⟹ 5V of Arduino
GND ofGSM ⟹ GND ofArduino

XI. CODINGPART

LDR_PIR_BULB_BUTTON | Arduino 1.6.12

File Edit Sketch Tools Help

LDR_PIR_BULB_BUTTON

```
#include<SoftwareSerial.h>
int BUTTON = 2;
int BULB1 = 12;
int BULB2 = 13;
int PIR1 = 7;
int PIR2 = 8;
SoftwareSerial mySerial(9,10);
void setup()
{
  mySerial.begin(9600);
  Serial.begin(9600);
  pinMode(PIR1, INPUT);
  pinMode(BULB1, OUTPUT);
  pinMode(PIR2, INPUT);
  pinMode(BULB2, OUTPUT);
  pinMode(BUTTON, INPUT_PULLUP);

  delay(100);

}
void loop()
{
  int value_ldr = analogRead(A4);
  int value_pir1 = digitalRead(PIR1);
  int value_pir2 = digitalRead(PIR2);
  int value_button = digitalRead(BUTTON);
```

XII. CONCLUSION

Old age support systems had progressively developed as an important field of control systems. The implementation of such systems continuously increased especially with the tendency to standardize their processes. In fact, the capability of devices of different kinds and issuing from various manufacturers to cooperate, communicate and function with high levels of harmony becomes an important factor. Moreover,

advanced processes and numerous techniques that are presented intend to reduce the prices of smart home, make the integrated system easier and handled with simplicity, and to achieve permanent degrees of security. The proposed home automation system is dedicated for elderly, people with disabilities, handicapped persons and others. It consists of remote control supported by command buttons and provided by alert LEDs and a LCD for showing messages. The remote control and itsbase are communicating with RF signals realized. In spite of designing our system for individuals that may require load efforts to move, it can be scalable for other users with the ability of appending multiple functionalities and various modalities. However, it can be also adopted in hospitals, health care centers andhospices.

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