NIDRA : The Sleepwalking Control Device

Rishab Dharmani(B17099)[1], Tushar Tyagi(B17106)[2], Sambhav Dusad(B17056)[3],
Shishir Singh(B17025)[4] and Shivam Kumar Bairwa(b17026)[5]

[1]b17099@students.iitmandi.ac.in [2]b17106@students.iitmandi.ac.in [3]b17056@students.iitmandi.ac.in
[4]b17025@students.iitmandi.ac.in [5]b17026@students.iitmandi.ac.in

Abstract— The project NIDRA aims at controlling the disorder of sleepwalking. Sleepwalking is an uncharted topic which hasnt been much pondered upon, which is also the uniqueness of this project. The project would help in preventing the dangerous violent behavior that accompanies a person when he/she sleepwalks and also save people from getting potentially lethal injuries, maybe even prevent death in some cases. The strap sensor combined with the alarm system (named NIDRA) senses when a person is walking at night and triggers an alarm near the caretaker/guardian of the sleepwalker. Keeping in mind the fact that sleepwalking is a disorder with no actual treatment possible and a symptom of many deadly diseases, NIDRA has an immense potential when it comes to suppressing the adverse effects of sleepwalking.

I. INTRODUCTION

NIDRA is a device which uses the orientation sensing properties of Gyroscope and serial communication properties of Arduino , in order to transmit and receive the alarm signal using RF module.

A. The components

The majority of components used in the project are discussed below:

- Arduino : Arduino is a system that , for its microcontroller, uses AT. It regulates all activities of the input/output system. Arduino consists of an Arduino Board as hardware part. For the software part, it has an IDE (Integrated Development Environment) that uses C-like as its software language. [1]

Fig. 1. Arduino

- Radio frequency(RF) Module : It is a small electronic device which consists of two components ,i.e. RF transmitter and receiver. As the name suggests, RF transmitter is used to transmit radio signals. The transmitter receiver pair operates at 433 MHz. The transmission occurs at the rate of 1Kbps - 10Kbps. The transmitted data is received by an RF receiver operating

at the same frequency as that of the transmitter. The corresponding frequency range varies between 30 kHz and 300 GHz. The main purpose of this module is to communicate with another device wirelessly. [2]

Fig. 2. RF Module

- Gyroscope (ADXL 335) : It is a 3-axis accelerometer which has signal based voltage outputs. It is tiny, less power consuming device, which can measure static acceleration as well as dynamic acceleration. The gyroscope can be used for just measuring the angles of a still object, the acceleration of a moving object or any shock or vibration endured by it. The range of acceleration it measures is between 3 g. The bandwidth can be selected in the range of 0.5 Hz to 1600 Hz for X and Y axes and 0.5 to 550 Hz for Z axis. The size of the chip is around 4 x 4 x 1.45 mm [3]
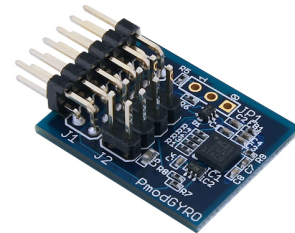

Fig. 3. Gyroscope

- Piezoelectric Buzzer : It is a diaphragm that is made of piezoelectric ceramic plate. The plate electrodes attached on both the sides. Across the electrodes, when we apply AC voltage, sound waves are produced in air [4].

Fig. 4. Buzzer

- Li-Po Battery : Lithium Polymer batteries are defined in 3 ratings i.e. Voltage, Capacity and Discharge rating. This is a 3S battery which means it has three cell pack and its voltage is 11.1V. The capacity of the battery is how much power it can hold which is 2200 mah. For the project two such batteries per device proved to be sufficient enough.[5]

B. Motivation Behind the Idea :

The motivation behind our idea lies in achieving the following : 1.SleepWalking is a disorder which is largely neglected by the people. Stats suggests that 10 Million people suffers from sleepwalking per year in India itself. It is much more common in children around 5-16 years of Age.

2.A Study by Dr. Dau Williers, Prof. of Physiology and Neurology at GUI-DE-CHAULIAC Hospital France suggests that :

- 22.83% people suffers sleepwalking on nightly basis.
- 43.48% suffers every week.
- 58% experiences violent sleep related behavior.
- 17% encounter at least one episode involving injuries.[6]

3. Our roommate,Saransh Sharma was also a big motivation behind our project. We came to know that he experienced frequent episodes of sleepwalking during his childhood which inspired us to do more thorough research in the idea.

4. SleepWalking is also considered as a disorder which cant be cured. It can be suppressed or prevented. NIDRA tries to prevent this disorder as much as possible.

Moreover, the name MUDRA itself draws its motivation from the Sanskrit word nidra (IAST)1 , which means sleep.

C. TARGET AUDIENCE :

This project primarily aims towards people whose body motion/movement sometimes turns out to be involuntary or subconscious. Including patients with all kinds of sleepwalking disorders so that they don't get into any kind of risk while unconscious.It can also be used for babies, foreseeing the situation that can arise when left alone or with less attention.

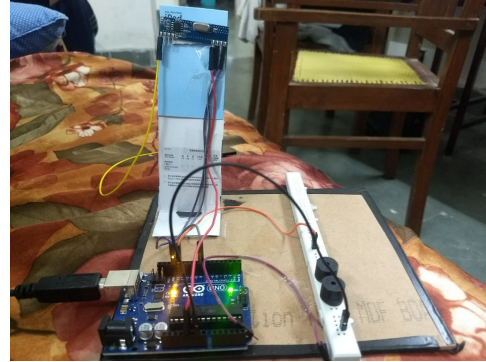## II. IMPLEMENTATION OF NIDRA

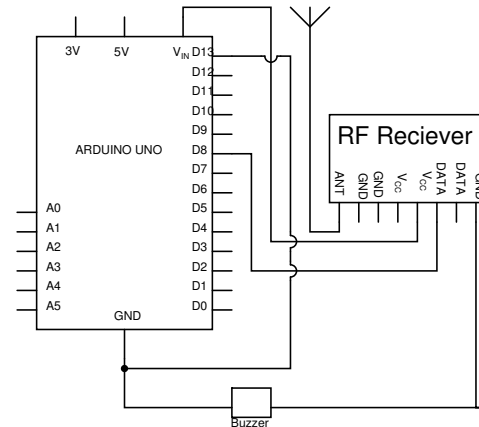- Making of the device

Fig. 5. Reciver End

Fig. 6. Reciver End
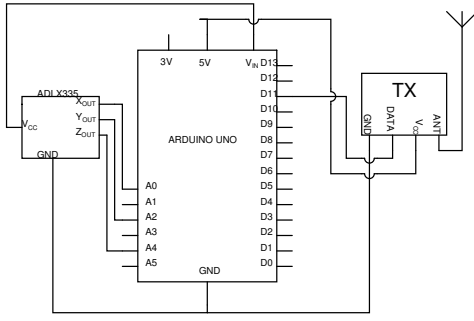

Fig. 7. Transmitter End

Fig. 8.   Transmitter End

For the working of device, a thigh strap (transmitter end) was made for the sleepwalker and a separate alarm system (receiver end) for the caretaker/guardian.

1) Firstly, the code is fed to the Arduinos both for the transmitter end (with gyroscope) and the receiver end. The pseudo code is shown in the following figure :

```
for(int i=0; i<3; i++)
{
  if(yv<-8.7 && xv<-6.7 && zv>-7.7)
    count++;
}
Serial.print("\n");
Serial.print("count = ");
Serial.print(count);
Serial.print("\n");

if(count==3)
{
    controller="1";
    vw_send((uint8_t *)controller,strlen(controller));
    vw_wait_tx();
    delay(200);
    controller="0";
    vw_send((uint8_t *)controller,strlen(controller));
    vw_wait_tx();
    delay(200);
}
```

Fig. 9.   Pseudo Code

2) Next the gyroscope is connected to the Arduino circuit board for the thigh strap. Then the transmitter of RF module is also connected.
3) For the alarm system, the receiver of RF module and the piezoelectric buzzer are connected to the Arduino board.
4) All the components were connected with wires and then soldered for stronger connections.
5) The transmitter end was attached to a strap that would fit on a persons thigh and the alarm system on a cardboard giving it a sturdy platform.

- Working Principle Of the Device
  1) For Sensing the orientation of the SleepWalker : In order to perceive whether the victim is sleepwalking or not, we needed to sense the placement of the persons thigh in 3D space. For this, we used ADXL 335 gyroscope which measures the change in angular velocity. With the appropriate calibrations, we sensed the direction of the patients thighs in all the three axis. Its functioning is based on elasticity of very tiny semiconductor beam inside the IC.
  2) For channelising the information of gyroscope sensor : The information collected by the gyroscope is used to setup the remote buzzer. This is done using Arduino UNO. Vcc pin and GND pin of gyroscope sensor is connected with Vin and GND of Arduino respectively. Three axis are connected to any of the three pins in Arduino

- How to Use
  1) The thigh strap is put on by the sleepwalker when he/she is about to sleep and switched on.
  2) The alarm system is switched on as well and placed besides the caretaker/guardian.
  3) The sleepwalking patient can sleep in any position he desires, the alarm wont go off but as soon as he gets up, still sleeping, it triggers the alarm to warn the caretaker about the situation.
  4) The caretaker guides the sleepwalker gently, without waking him up, to his own bed.

III. FINANCES

Table showing the total cost, component wise:

TABLE I

COST TABLE

Components Used	Quantity	Cost
Arduino Uno	x2	1098
RF Module	x1	285
Gyroscope	x1	500
Piezoelectric Buzzer	x2	80
Li-Po Battery	x1	699
Connecting Wires		100
Other Expenses		50
Total		**2812**

The Total cost for the production of NIDRA is 2812 which can be reduced once mass production starts.

IV. CONCLUSIONS

- Advantages Of the Project :
  1) Prevention to incurable disease : SleepWalking is an incurable disorder. NIDRA is preventing any serious injuries caused to the patient during sleepwalking.
  2) Considering basic facts : A sleepwalker should never be awaken from sleep as his mind is in unconscious state and sudden change can cause shocks or trauma and in some cases, patient can become violent. The buzzer is therefore, put in a loved ones room so that he can gently guide the patient back to the bed.

3) Cost Effective : Total cost of our product is only 2812. Sleepwalking makes a patient very vulnerable to any damages. NIDRA takes into consideration every possible case and prevent any serious damage from happening.
4) Accurate and Efficient : NIDRA shows very accurate results as it triggers the alarm only when the sleepwalker stands upright. He/she can sleep in any unconventional position he/she wants to without fearing the alarm to go off.
5) High Range : NIDRA can work over a range of 30-40 m, can cover an entire floor, regardless of the number of walls/obstructions in between and can even work across floors to a certain extent.

- Future Implementations in the Project: Some of the improvements that can be made in the project are as follows:

  1) Using a more reliable transmission device: The current RF transmission can be replaced/enhanced by a GSM module or a WiFi module for better transmission with less chance of false alarm triggering.
  2) Daily Sleep Analysis: The patients daily sleep record can be stored using a WiFi Module and an App for further analysis and to keep a track of the disorder.
  3) More Compact Model: The model can be made more compact by using Arduino Nano instead of Arduino Uno.

V. ACKNOWLEDGEMENT:

REFERENCES

[1] Adriansyah and A. W. Dani, Design of small smart home system based on arduino, in 2014 Electrical Power, Electronics, Communications, Control and Informatics Seminar (EECCIS), pp. 121125, Aug 2014 - arduino Slides of Dr. Kunal Ghosh (Assistant Professor,IIT Mandi) and Instructions of Dr. Hitesh Shrimali (Assistant Professor,IIT Mandi).
[2] RF Based Wireless Remote using RX-TX MODULES 434MHz.
[3] Analog Devices - Small, Low Power, 3-Axis 3 g Accelerometer ADXL335 20092010 Analog Devices, Inc. http://www.analog.com/media/en/technical-documentation/data-sheets/ADXL335.pdf
$[https://www.elementzonline.com/downloads/RF_Based_Wireless_Remote.p$
[4] MIT OpenCourseWare 6.S079 Nanomaker Spring 2013 Lecture Slides 9: Piezoelectricity and Thermoelectricity $[https : //ocw.mit.edu/courses/electrical - engineering - and - computer - science/6 - s079 - nanomaker - spring - 2013/labs/MIT6_S079S13_slides09.pdf]$
[5] A guide to understanding Li-Po Batteries $https : //www.elementzonline.com/downloads/RF_Based_Wireless_Remote.pdf$
[6] Functional Impairment in Adult Sleepwalkers: A Case-Control Study $www.ncbi.nlm.nih.gov/pmc/articles/PMC3571741/$