NAYAN

AN AID FOR THE ELDERLY

J COMPONENT REPORT

Submitted in partial fulfilment of the requirements for project on the course

Lean Start-up Management

Course Code: **MGT1022** (Slot: TE1)

by

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Vellore Institute of Technology
(Deemed to be University under section 3 of UGC Act, 1956)

November, 2020

DECLARATION

We hereby declare that the project entitled "**NAYAN**" submitted by us to Vellore Institute of Technology, Vellore is partial fulfilment of the requirement for the award of marks for the subject Lean Start-up Management (Course Code: **MGT1022**) is a record of bonafide work carried out by us under the supervision of **Prof. Jose S**.

We further declare that the work reported in this project has not been submitted and will not be submitted, either in part or in full, for the award of any other degree or diploma in this institute or any other institute or university.

Place: Vellore

Date: 06/11/2020

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CERTIFICATE

This is to certify that the project report entitled "**NAYAN**" submitted to Vellore Institute of Technology, Vellore, in partial fulfilment of the requirement for the award of marks for the subject Lean Start-up Management (Course Code: MGMT1022) is a record of bona fide work carried out by them under my guidance. The project fulfils the requirements as per the regulations of this Institute and in my opinion meets the necessary standards for submission. The contents of this report have not been submitted and will not be submitted either in part or in full, for the award of any other degree or diploma and the same is certified.

Place: Vellore

Date: 06/11/2020

ACKNOWLEDGMENT

We would like to sincerely thank our respected faculty Prof. Jose S without whose guidance, it would have not been possible for us to do this project. His valuable guidance, support and supervision all through this project are responsible for attaining its present form. Thanks also go to our friends, colleagues and the department staffs for making this project a great experience. Finally, thanks to our family for their encouragement and support throughout our course of learning. In the course of doing this project we learnt many new things about how a wearable sensor, obstacle detection system, fall detection system can be made by using sensors and Microcontrollers.

ABSTRACT

Falls represent a major public health risk worldwide for the elderly people. A fall not assisted in time can cause functional impairment in an elder and a significant decrease in his mobility, independence and life quality. **NAYAN** is a wearable belt which will be connected to an App. This belt will be made on the motivation to help elder Blind, cataract, glaucoma patients and the problems which they face in their everyday lives.

The major issue which they face is while walking they cannot see any rear obstacles and that's why they fall down very frequently and when they fall it is not necessary that someone is always there to help them. Hence our present work proposes an innovative IoT-based system for detecting falls of elderly people in indoor environments, which takes advantages of low-power wireless sensor networks, Microcontrollers, Application Development using Android Studio.

Commonly, fall detection systems use a gyroscope and an accelerometer. A gyroscope is used to determine an orientation and an accelerometer provides the information about the angular parameter as three-axis data. But we also need to decide a threshold so that the system can differentiate between a fall and normal activity. For this purpose of Fall Detection, a 3D-axis accelerometer and Gyroscope (MPU6050) is used with Arduino Uno device wearable is used, which is responsible for collecting data from movements of elderly people in real-time. The results of experiments have shown high success rates in fall detection in terms of accuracy, precision and gain.

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INTRODUCTION

The World Health Organization (WHO) states that death by fall is the second leading cause of accidental or unintentional injury death worldwide. A study has estimated that an average of 646,000 individuals die from a fall globally. The percentage of adults over 65 years of age who become victims to this cause has increased to 30% from 2007 to 2016. A tremendous increase in the growth rate was observed among the adults of age 85 years and above with an increase of 4% every year.

The prevailing situation not only affects the quality of life of the old but also inculcates a fear of falling syndrome (FoF) and sometimes leads to chronic disabilities. For instance, an elderly person who is physically weak cannot get up after collapsing and he/she tends to lie on the floor for more than an hour. This is a clear indication for the elderly to be suffering from pneumonia, dehydration, pressure sores or hypothermia. The probability of death of the elderly within the next few months is almost 50%.

The urgency of this plight requires an advanced attention. One of the most efficient ways of dealing with this problem is using an automatic easy-to-deploy system which would detect the obstacles and require minimal assistance. Commercializing this system into a wearable device is a prudent approach to adopt this strategy. Sensors present in these devices measure the body movements to predict falls.

Development of a reliable Fall Detection System (FDS) has become an area of interest for researchers and organizations in telemedicine that work for the welfare of the older community. A Fall Detection System is a binary classification system that distinguishes a falling event from the other regular activities of the user. An FDS could either be a Context-Aware-System (CAS), also known as surveillance-based system, or a wearable system. In a CAS, sensing units are present in the user's immediate environment. It is a vision-based tracking system which employs cameras, depth sensors, radars, microphones, acoustic sensors etc that monitors the user's movements in a given set of locations.

Sensors like accelerometers, gyroscopes and in some cases, magnetometers, are gaining popularity in recent times due to their low power consumption capacity, low cost, portability and their ability to easily get embedded in any wearable device. The most common was of availing this method is using a smartphone.

An FDS based smartphone makes use of an inertial measurement system and a multi-interface wireless communication technology. Fall detection primarily takes place by analysing the signals sent by the sensors. However, it is not always easy to predict or state a determined and definite reason for a fall. To overcome the traditional analysis, certain pattern is recorded and sent to the Microcontroller board. Further the results are sent to the smartphone application of the related group for taking up the necessary actions.

In this project, we are trying to develop a waist mounted wearable for fall detection system (FDS). NAYAN is a wearable belt which will be connected to an App. This belt will be made on the motivation to help elder Blind, cataract, glaucoma patients and the problems which they face in their everyday lives.

RELATED LITERATURE

For this project, one of the research papers we focused on is **"Development of a Wearable-Sensor-Based Fall Detection System"** by International Journal of Telemedicine and Applications which was received on 6 August, 2014 and published on 16 February 2015. This paper established a Fall Detection Method based on a wearable device based on a single triaxial accelerometer. The mounting orientation of the system is not expressly necessary because the algorithm does not assert that the accelerometer axes are strictly fixed. The system has a hardware architecture with low power consumption and a highly efficient algorithm that can extend the wearable device's service time. Both the software and hardware designs are sufficient for outdoor and wearable applications.

Another paper we focused on was **"Fall Detection Sensor System for the Elderly"** by International Journal of Advanced Computer Research which was published on June 2015. This paper introduced the design and implementation of a fall detection sensor device using the four features mentioned in Section 5 (Weightlessness, Impact, Motionless, and Initial Status) as the parameters for detecting and computing a fall. For elderly people who live alone at home, this device is useful to ensure their personal safety, in which the system alerts the contact person after a fall event has occurred. The ambulance department will also be contacted to reach the dropping site and provide the elderly with medical care as soon as possible.

International Journal on Smart Sensing and Intelligent Systems published a paper titled **"Fall Detection And Prevention For The Elderly: A Review Of Trends And Challenges"** which was accepted on April 30, 2013 and published on June 5, 2013. This paper presents an extensive review for the state-of-the-art trends and technologies of fall detection and prevention systems assisting the elderly people and their caregivers. Furthermore, this paper discusses the main challenges, facing elderly fall prevention, along with suggestions for future research directions.

EXISTING MODELS

Some of the products or solutions already available in the market are:

1. TELLMATE

   Tellmate is a wearable computer vision device in form of glasses which will process in-front images of Visually Impaired Person, will convert it to sound and whisper in the ear using hearing aids.

2. MEDICAL GUARDIAN

   Medical Guardian has been a leading provider of medical alert systems for seniors for several years. They were founded in 2005 by Geoff Gross, who wanted to disrupt the medical alert industry after his own grandmother suffered from falling at home alone.

3. BRAILLE ME

   It's a machine that plugs into mobile phones and computers to help the visually impaired access the internet and other digital content. It's equipped with a tool to let people write in braille and have it appear in digital text, as well as one that converts digital text into raised bumps for readable braille. Every time a person finishes reading a line, they can press a handy little "next" button to move to the next one.

4. LIFEFONE

   LifeFone is a medical alert system company that offers emergency response systems for those who spend most of their time alone. LifeFone's home and mobile medical alert systems have nationwide cellular coverage, immediate assistance and personalized emergency care instructions. LifeFone also has options for smoke, fire and carbon monoxide monitoring services. All LifeFone monitoring centers are located in the United States and staffed with experienced personnel.

5. BAY ALARM MEDICAL

   Bay Alarm Medical is a popular option for budget-minded seniors and their caretakers. Unlike most other medical alert companies, Bay Alarm Medical markets its device

toward teens and parents, not just the elderly. Monitoring options include a pendant or a wristband, but you can also request the plug-in On The Road device for vehicle monitoring. The On the Road GPS device features integrated crash detection, and it contacts the call center if an accident occurs.

6. BASIC WALKING STICKS

   Regular walking sticks which help the user percept the surroundings around him and make movements accordingly

7. HIRING AN AAYAH/ BEING DEPENDENT ON AN EXTERNAL HELP

What do these solutions lack?

Even though these solutions are innovative and are appropriate in their own respect, they have some gaps. TELLMATE and BRAILLE ME are too tech savvy and are highly priced starting from Rs 7000 and going all the way to around Rs 20000. The other simple solutions like having a walking stick for that matter is just too simple and does not suffice the need.
Hiring an aayah or being dependent on another person becomes too much of a concern and the daily life of the elderly would be disturbed if the external help fails to show up.
What the target customer requires is something simple, which does not need be technology heavy. Gives them a sense of self dependability and something which is not a punch in their pockets.

This is where "NAYAN" comes in

INTENDED IMPACT OF THE PRODUCT

According to Population Census 2011 there are nearly 104 million elderly people (aged 60 years or above) in India; 53 million females and 51 million males. A report released by the United Nations Population Fund and HelpAge India suggests that the number of elderly people is expected to grow to 173 million by 2026.

In a country like India where there is a major population of the elderly, it becomes imperative to come out with a product which caters to their needs and interests. Now coming to the situation, we are currently faced with that is COVID 19. Majority of the country is facing lockdowns and people all around are facing various difficulties. The elderly are forced to remain alone and do all the work without much help. The product that we have thought of developing certainly gives them an amount of freedom and courage to go about their usual business without much worry of falls or any other mishap.

During times like these where the Prime Minister is encouraging every citizen to "Be local and be vocal about local" and pushing for the "**Make in India**" concept, our product seems to be a step in the right direction in a market which has a huge scope in the future for further development and also in an area where there is not much R&D done at the moment

In the current scenario, there are either just expensive software-based solutions or very simple hardware-based solutions which are very unreliable and not up-to the mark leaving the target audience unsatisfied. This is where our product would come in, which would be an amalgamation of both software and hardware in a smart way with the usage of top-notch technology with a price range which would not make the targeted customer fret.

METHODOLOGY

Commonly, fall detection systems use a gyroscope and an accelerometer. A gyroscope is used to determine an orientation and an accelerometer provides the information about the angular parameter as three-axis data. But we also need to decide a threshold so that the system can differentiate between a fall and normal activity.

We use the threshold-based detection system and check whether a parameter is above a certain threshold value within a time interval. In a fall situation, there is a large change in acceleration within a split second and then after the fall, the person lies still for some time, showing no change in orientation. Knowing these details allows us to create the algorithm.

First, we will collect data from the accelerometer and then calculate the acceleration magnitude. Acceleration magnitude tells us about how quickly velocity changes while acceleration tells us the rate of change in velocity.

After calculating the acceleration magnitude, we need to know if its value breaks the lower threshold. The lower threshold is the minimum threshold in the range decided by us and the value gradually increases up to the high threshold. Then we need to check that it breaks the high threshold in some milliseconds for example 500ms.

If all of these are detected as true conditions, then we check whether there is a change in orientation within 500ms and usually, it's true if the above conditions are true. After that, we check to see if orientation remains the same for some time. If yes, then there was a fall. There is a loop, meaning that if a condition is false at any stage, the process goes back to start and re-executes.

REQUIRED MATERIALS

1. Arduino UNO
2. MPU6050 accelerometer and gyroscope breakout module
3. Jumper Wires
4. LED
5. Resistor – 10k Ohm
6. Arduino IDE (Software)

ALGORITHM

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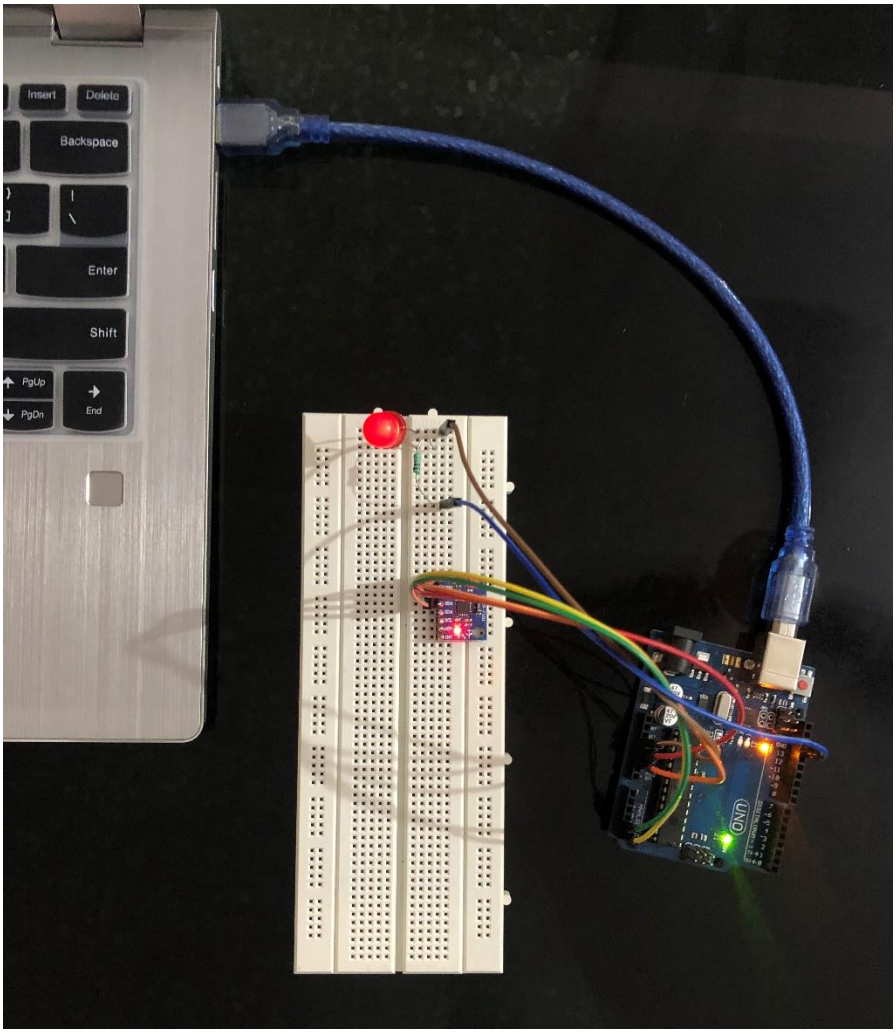
FALL DETECTOR CIRCUIT

- The circuit is built around an Arduino UNO and an MPU6050 accelerometer and gyroscope breakout module. For collecting data, we rely on the MPU6050 module to give analog input to the Arduino UNO. The MPU6050 module provides six values as output, three values of an accelerometer, and three values of a gyroscope. It is a sensor-based on MEMS (micro-electro mechanical systems) technology and uses I2C protocol for communication. Sensors like this are widely used in smartphones, robotics, 3D modeling, UAVs, and more.
- The MPU6050 consists of a three-axis gyroscope, a three-axis accelerometer, a digital motion processor, and an on-chip temperature sensor. We are using A4 and A5 pins of the Arduino UNO for data reception.

PSEUDO CODE

1. Collect data from the module
2. Calculate magnitude of acceleration.
3. Check if the value of magnitude breaks the lower threshold. If false, return to Step 1.
4. Check if the magnitude breaks the higher threshold in 0.5 seconds. If false, return to Step 1.
5. Check for change in orientation within 0.5 seconds. If false, return to Step 1.
6. Check if orientation remains same for 10 seconds. If false, return to Step 1.
7. Change the output pin as HIGH on the detection of fall (if all of the above steps are resulted as true).



CUSTOMER SURVEY

We contacted in total 11 customers via an email in which a brief product description was provided along with a link to the survey If they wanted to provide some feedback. They were:

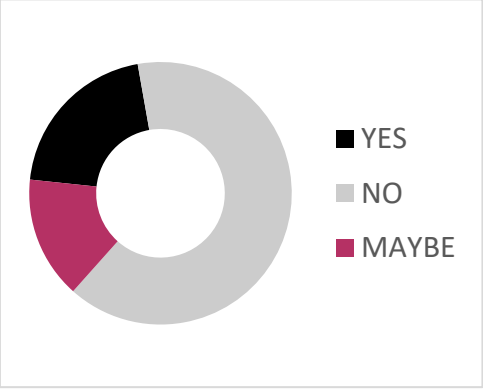
1. **OLD AGE HOMES**
    - Aghoreshwar Bhagwan Ram Vriddhashra – Varanasi
    - Samarpan Varishtha Jan Parisar – Lucknow
    - Shashiraj Foundation – Delhi
    - Aastha Health Resort – Lucknow
    - Roshan Smriti- Assisted Living for Seniors – Noida

2. **HOME CARE SERVICEs & HOSPITALS**
    - Vardaan Senior Citizen Center - Delhi
    - City Care Home Nursing Services - Lucknow
    - Reach Apollo Home Healthcare - Delhi
    - Aastha Geriatric Hospital & Hospice - Lucknow
    - Portea - Heal at Home

3. **LUXURIOUS OLD AGE HOMES**
    - The Golden Estate – Faridabad, Haryana

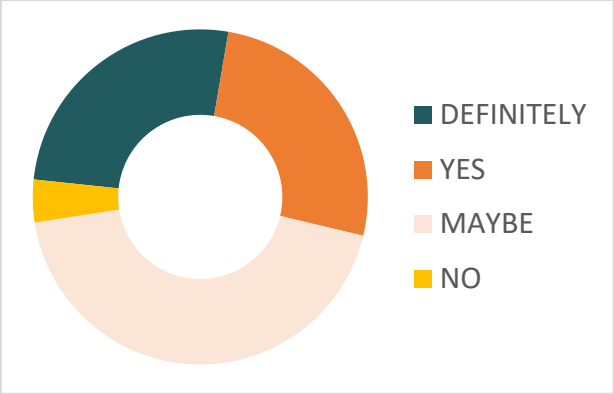
AWARENESS ABOUT SIMILAR PRODUCTS IN THE MARKET

More than half of the people who responded didn't quite actually know about the type of product being discussed was available in the market or not.

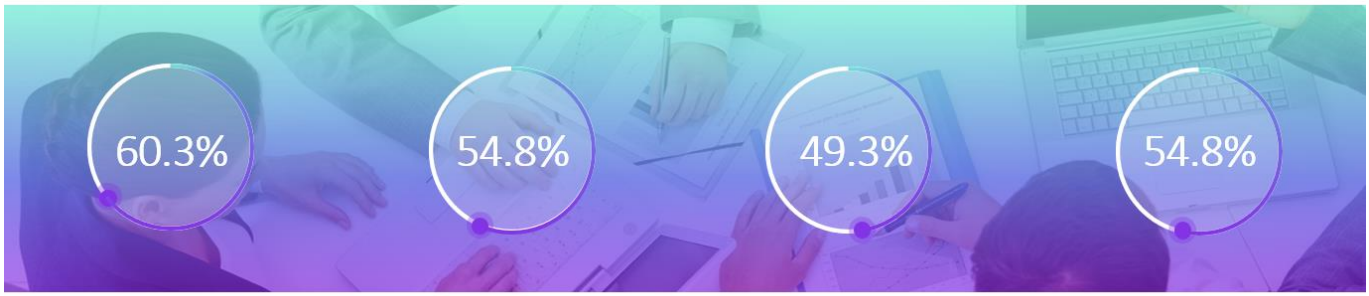


CAN OUR PRODUCT REPLACE THOSE ALREADY EXISTING?

Those who knew about existing products voted that there is a good chance for our product to replace the traditional products already available in the market



ATTRACTIVE FEATURES



Obstacle Detection

44 people liked this feature

GPS

40 people liked this feature

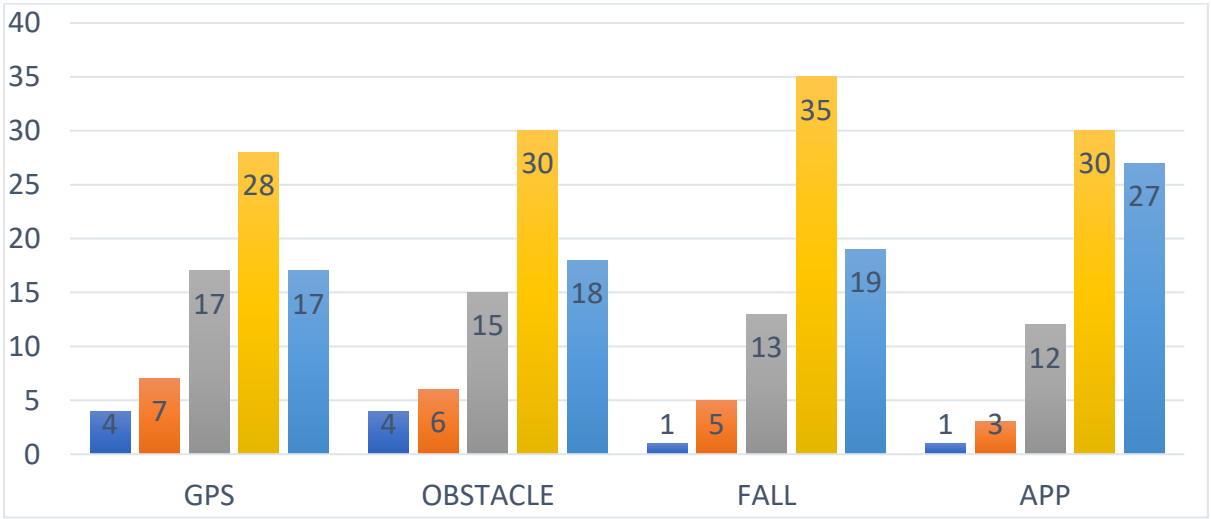
APP

36 people liked this feature

Fall Detection

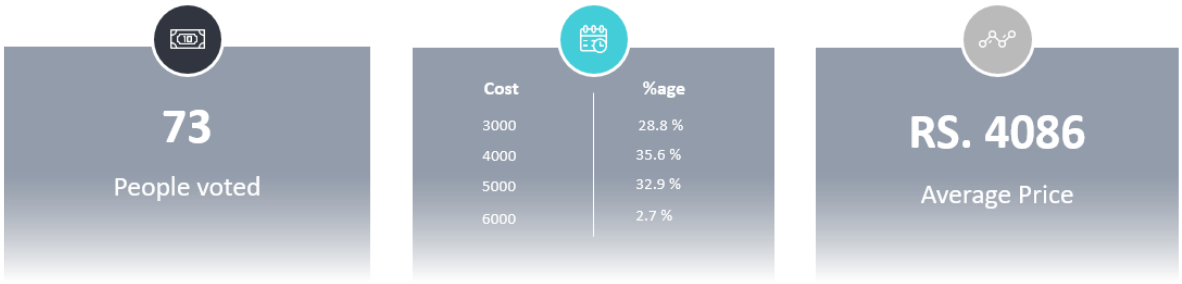
40 people liked this feature

The important features according to the data were:

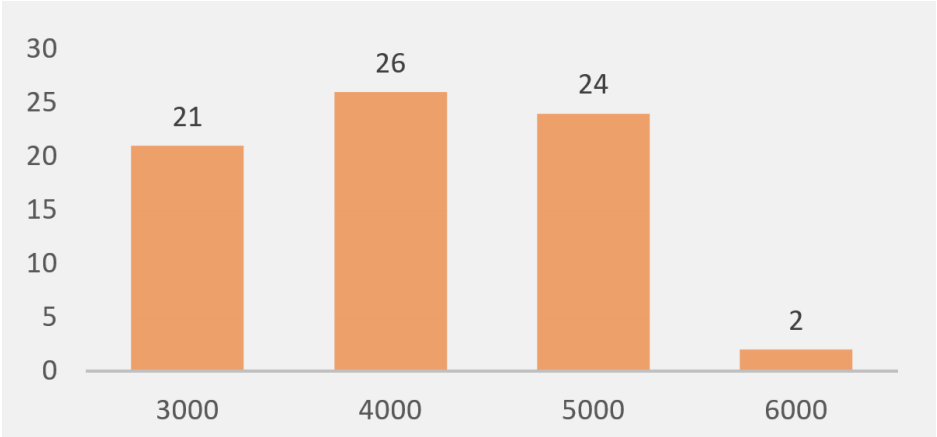


We asked our potential customers about the feature that they feel is the most important and that will help the elderly the most. They were asked to rate each feature from 1 to 5.

EXPECTED PRICE



Almost 69% of the people who participated in this survey think that a price between Rs.4000 – Rs.5000 would be justifiable.



ADDITIONAL FEATURES

Oximeter

People thought that having an oximeter in the belt would be a good feature to add especially in the time of COVID

Step Counter

A step counter would come in handy as an optional feature rather than as an important feature

Pulse Monitor

Adding a pulse monitor would help keep track of health of the elderly who have heart related problems

Lightweight

Well since the belt is for elderly, customers want it should be as lightweight as possible so the elderly is comfortable using it

TO SUMMARIZE

- **Objective**

  The first and most important objective to conduct this survey was to know more about our target audience, how they will react to our product, what are they expecting and what price are they willing to pay for the product.

- **Conclusion**

  Results from the above survey indicate that most of the customers' requirements are met by our product and the pricing that we projected for our product was widely accepted by most of the survey participants/customers.

- **Recommendations/Learning**

  Few of the customers requested additional features to be incorporated in our product, which were in their regard considered important. The takeaway from this survey is highly positive and that has motivated us to develop a more refined product for our customers.

COST ANALYSIS

Considering the breakdown of all components we will use in our project; the budget of our wearable would be approximately around Rs. 4100

COMPONENTS	COST
ARDUINO	500
2X ULTRASONIC SENSORS	180
5X LEDs (as vibration sensors)	10
WIRES	25
NODE MCU	320
GY-521	300
2X VIBRATION MOTORS	120
PCP FABRICATION	755.92
APP DEVELOPMENT	1888.61
TOTAL	**4099.3**

MARKETING STRATEGIES

For the product we have conceptualized, a dual-prong approach can be used to market it successfully to a diverse and widespread audience. In order to market any product, it is essential to understand its Unique Selling Proposition or USP.

For our product its biggest USP is the price we are proposing for it. At the price we are offering our product for, there is no truly no competitor in today's market. The price point makes the product widely accessible and easy to market an economically diverse demographic. This proposition should be highlighted in any and every advertisement for the product.

Another important USP that must be highlighted is the ease of use of the product. It is simple to use and does not require any kind of technical expertise, which makes it extremely conducive for use by senior citizens, our primary target demographic.

Now coming to the techniques to be used, we will invest heavily in a video advertisement which will be displayed as a TV commercial and also on platforms such as YouTube.

The concept for the advertisement will centre around the plight of senior citizens who have difficulty in basic movement and are largely abandoned by loved ones, left to navigate their world alone.

We will use sombre music and bleak lighting in the first half of the advertisement when an old man having problems maintaining his balance and falling down will be shown. Another old man will appear who will help the hurt old man, and then tell him about his experience with our product and persuade him to try it out for himself. Then we will cut to them walking away laughing together, and the name of the product along with a tagline and price will be displayed on screen. The advertisement has to be crisp and must be wrapped up within thirty seconds.

We will also expand our reach by using social media applications such as Facebook and Instagram.

Apart from these, we have taken the initiative to approach several organizations with like-minded individuals who wish to help the elderly.

BUSINESS MODEL

Product-Service System (PSS)

The product-service system (PSS) offers opportunities for companies interested in gaining a competitive advantage in today's marketplace by introducing new ways of dealing with businesses, customers' value chain. The PSS shifts the traditional business approach based on designing and selling physical products to a approach focused on delivering products and services that can meet user needs

The PSS consists of tangible products and intangible services designed and combined so that they are jointly capable of fulfilling specific customers' needs.PSS is a system of products, services, infrastructure and network support that continually strives to be competitive, satisfy customer needs and can result in less environmental impact than traditional business models.

In traditional business models, the customer purchases a product and becomes responsible for monitoring its performance, maintenance and adequate disposal. In contrast, according to the PSS concept, the manufacturer earns revenue from the customer for providing a function. Thus the ownership of the product is not necessarily transferred to the customer. The manufacturer remains responsible for maintaining the product along its life cycle and for discarding it .

The PSS concept has the potential to benefit both companies and customers. The main advantages for the customers are: more customized supply and higher quality; new functionalities and combinations of products and services to better suit customers' needs and; responsibility for monitoring and end-of-life tasks transferred to the manufacturer. For companies, some advantages are: new market opportunities and competitive advantages; alternative to standardization and mass production; higher total value delivered to the customer by increasing service elements and; access to information about product's performance during its use.

The PSS may also result in a number of environmental benefits. As companies become responsible for the entire life cycle of their products, they are encouraged to take them back at their end of life, reuse or remanufacture them, and place them on the market again. Therefore, less waste is discarded, thereby reducing the consumption of raw materials and energy. These practices lead to a more sustainable production system.

PSS Elements for a Business Model

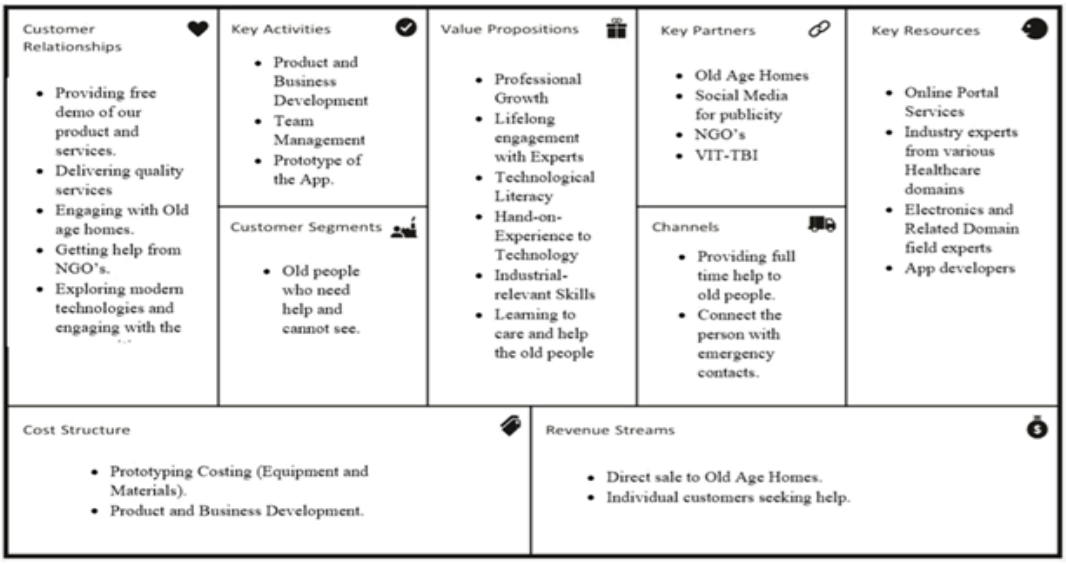
Because of the differences between the PSS and the traditional way of doing business (product selling), one of the main challenges faced by companies that adopt the PSS is to identify specific requirements in the business model. Thus, based on our literature review, we describe below some of the main characteristics of the PSS business model, which are showed according to the elements of the Canvas business model:

1. **Value Propositions:** These are related to the value provided by a PSS through the integration of products and services. Examples of value proposed in a PSS are: function guarantee; cost reduction in manufacturing operation, since services such as maintenance and repair are responsibility of the PSS provider.

2. **Customer Segments:** It is important to consider the kind of opinions specific target group has about products ownership, since in some of the PSS types this ownership will not be transferred to the client, keeping with the producer. In a PSS, a good way to define the customer segment is to consider the different types of user behavior, since PSS involves changes in ownership, responsibility, availability and cost.

3. **Distribution Channels:** Sales and retail departments should define how the PSS should be offered to make it more attractive than buying a product-based option. Another important aspect is to sell the PSS concept through marketing campaigns.

4. **Customer Relationships:** This element involves the creation of added value and its delivery through direct relations and intensified contacts and detailed contracts with customers, which enables the development of long-term customer relationships.



FUNDING

We have planned to obtain the initial investment through Stand-Up India programme, under the Start-up India scheme. Following is an attached form for registering a loan through this scheme. The Stand-Up India Initiative can supply a loan up to INR 5lacs to entrepreneurs, for their start-up endeavours.

Other avenues for funding include the following:

1. ANGEL INVESTORS: Also called angel funder and seed investor is an individual who pays capital for a business start-up. They invest online and form networks called angel groups to share investments. They basically focus on companies they are sure can make good profit. They screen the proposals and offer advices along with the capital. Many prominent companies like Google, Yahoo etc. were assisted by angel investors.

   The Chennai Angels is a group of angel investors. It is mentored by more than 70 experienced entrepreneurs who are ready to nurture success and fund start-up ideas.

   Various professors from the top colleges of India and a number of businessmen and engineers serve as the angel investors and nurture new start-up ideas.

• Ventures with unique ideas with potential for rapid, scalable growth within a reasonable time frame.

• Businesses with proprietary technology, early market lead and other strong barriers to entry.

• A strong management team to execute the business plan, with relevant and successful experience.

• Entrepreneurs who can provide evidence of the validation of their concept and particularly those who have begun to engage with the market have a stronger proposition.

2. MICROSOFT FOR START-UPS: Microsoft has partnered with a number of start-up accelerators and incubators all over the world to offer exclusive benefits. Some of its sponsors are:

- Gen Next Hub (Reliance)
- Entrepreneur's Roundtable Accelerator
- Startech
- Zone Start-ups
- India TechStars

Microsoft offers engagements with other start-ups, along with access to recent technology, and new community spaces that promote collaboration across local and global ecosystems.

Digital and social campaigns to promote your solution at launch. A customized Go-To-Market plan to maximize joint marketing with Microsoft Targeted industry co-marketing and account planning

3. LETSIGNITE CROSS BORDER (INDIA'S FIRST GLOBAL INVESTOR SUMMIT):

Letsignite Cross Border is the first investor summit aimed at providing global investments for start-ups. Being sponsored by NetApp Accelerator and PayU, it is a joint initiative by LetsVenture and Swissnex India, the Consulate General of Switzerland.

4. GOVERNMENT PROGRAMS THAT OFFER START-UP CAPITAL:

Indian government has launched 10,000 Crore start-up fund and the Bank of Ideas and Innovations Program. The popular Pradhan Mantri Micro units Refinance Agency Limited (MUDRA) is launched by the government that extends profits to 10 lakhs to small and medium enterprises. Once the business plan is approved, the loan is sanctioned and a MUDRA card is provided which can be used for the expenses for the start-up.

5. NASSCOM'S 10000 START-UPS:

'10000 start-ups' is an initiative by NASSCOM to enable funding and support for 10000 start-ups in India. Being leaded by the President Debjani Ghosh, it has Start-up Haryana, Government of Karnataka, Government of Kerala, Indian Angel Network, Webel etc. as its partners. The aim is to identify and groom high potential start-ups through the best of global market exposure, industry connects and market access. It is funded mainly by SAIF Partners, Axilor, and ICP-Inventus.

MICROFINANCE PROVIDERS (OR NBFCs):

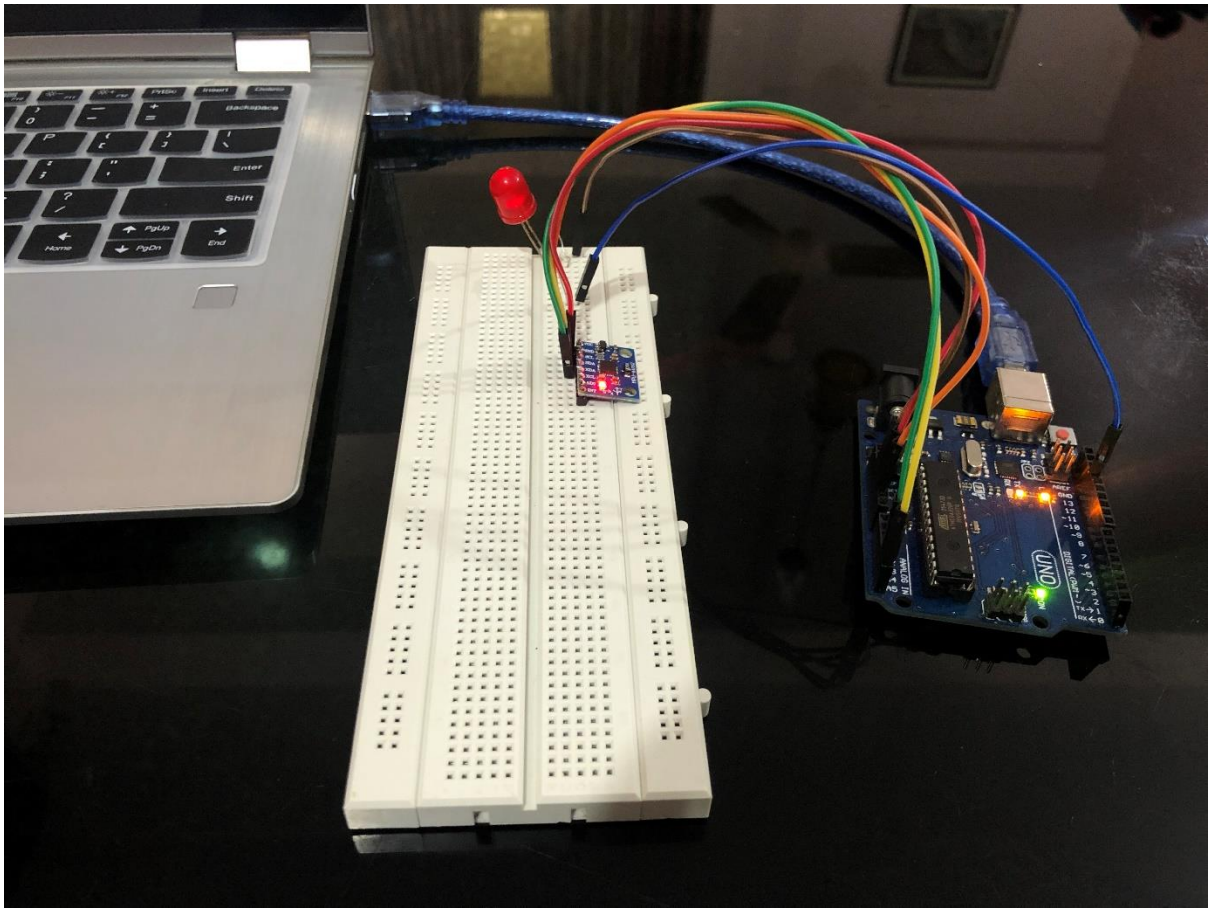
If qualifications for the bank loan are not met, Microfinance Providers and Non-Banking Financing Corporations are helpful. These corporations provide banking services without meeting the legal requirements of a bank.

(f) BANK LOANS:

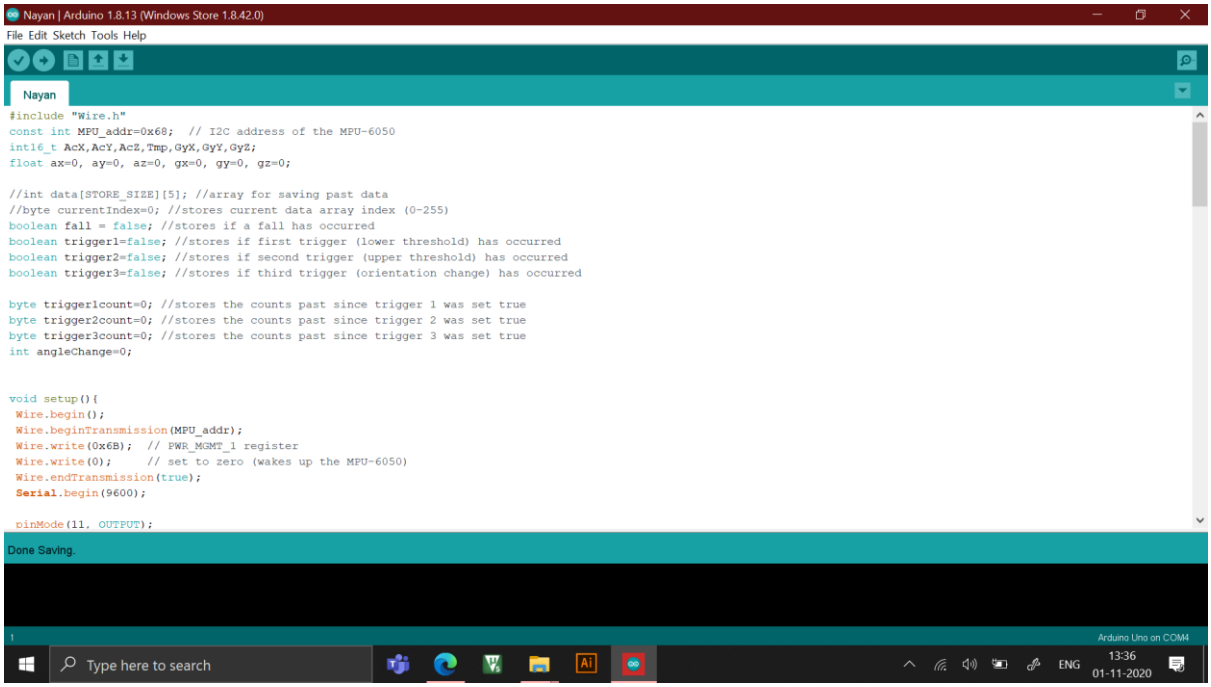
Funding from banks involves usual process of sharing the business plans on the basis of which the loan is sanctioned. Leading banks like Axis Bank, HDFC, ICICI, Bank of Baroda have a variety of options to offer loans.

SIMULATION RESULTS

For Fall Circuit:



Code:


Nayan | Arduino 1.8.13 (Windows Store 1.8.42.0)
File Edit Sketch Tools Help
Nayan
#include "Wire.h"
const int MPU_addr=0x68; // I2C address of the MPU-6050
int16_t AcX,AcY,AcZ,Tmp,GyX,GyY,GyZ;
float ax=0, ay=0, az=0, gx=0, gy=0, gz=0;
//int data[STORE_SIZE][5]; //array for saving past data
//byte currentIndex=0; //stores current data array index (0-255)
boolean fall = false; //stores if a fall has occurred
boolean trigger1=false; //stores if first trigger (lower threshold) has occurred
boolean trigger2=false; //stores if second trigger (upper threshold) has occurred
boolean trigger3=false; //stores if third trigger (orientation change) has occurred
byte trigger1count=0; //stores the counts past since trigger 1 was set true
byte trigger2count=0; //stores the counts past since trigger 2 was set true
byte trigger3count=0; //stores the counts past since trigger 3 was set true
int angleChange=0;
void setup(){
Wire.begin();
Wire.beginTransmission(MPU_addr);
Wire.write(0x6B); // PWR_MGMT_1 register
Wire.write(0);   // set to zero (wakes up the MPU-6050)
Wire.endTransmission(true);
Serial.begin(9600);
pinMode(11, OUTPUT);
Done Saving.
Arduino Uno on COM4
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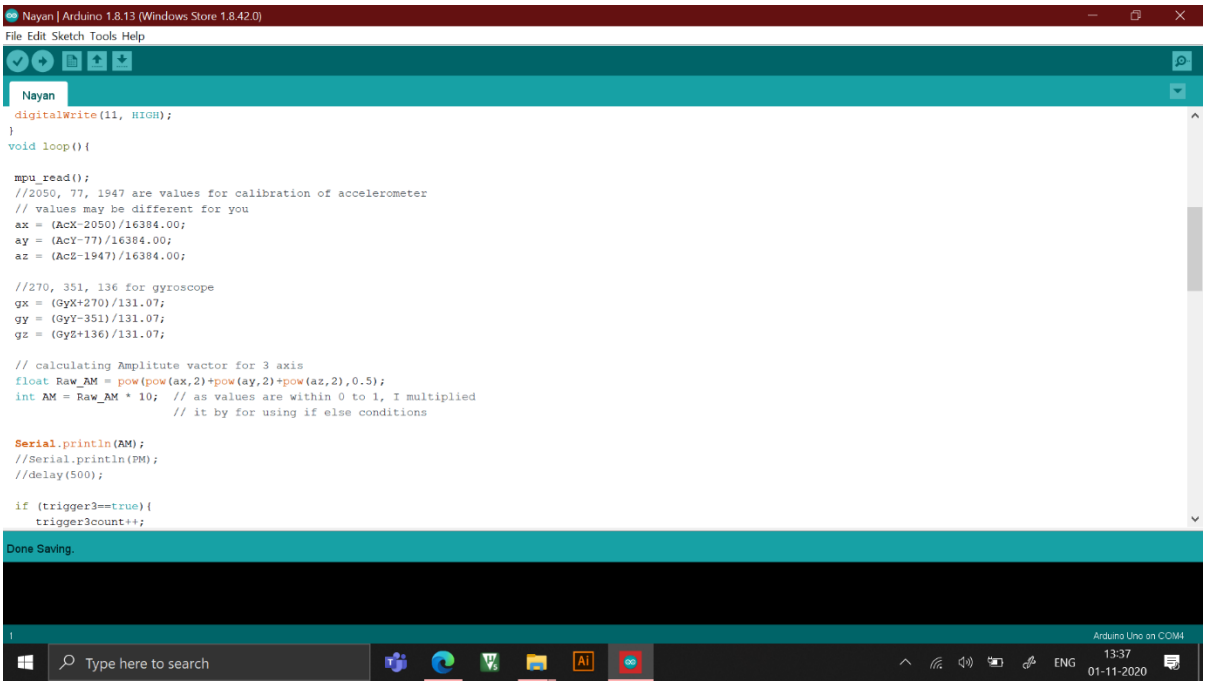
Nayan | Arduino 1.8.13 (Windows Store 1.8.42.0)
File Edit Sketch Tools Help
Nayan
digitalWrite(11, HIGH);
}
void loop(){
mpu_read();
//2050, 77, 1947 are values for calibration of accelerometer
// values may be different for you
ax = (AcX-2050)/16384.00;
ay = (AcY-77)/16384.00;
az = (AcZ-1947)/16384.00;
//270, 351, 136 for gyroscope
gx = (GyX+270)/131.07;
gy = (GyY-351)/131.07;
gz = (GyZ+136)/131.07;
// calculating Amplitute vactor for 3 axis
float Raw_AM = pow(pow(ax,2)+pow(ay,2)+pow(az,2),0.5);
int AM = Raw_AM * 10; // as values are within 0 to 1, I multiplied
// it by for using if else conditions
Serial.println(AM);
//Serial.println(PM);
//delay(500);
if (trigger3==true){
trigger3count++;
Done Saving.
Arduino Uno on COM4
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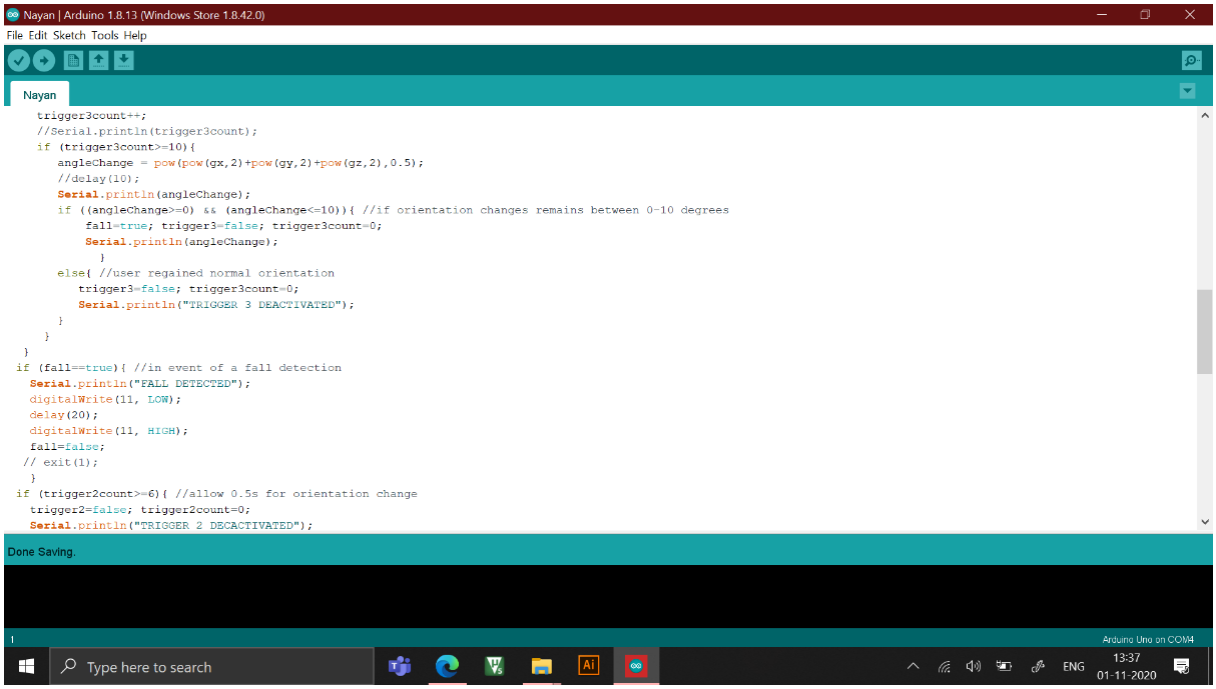
01-11-2020


Nayan | Arduino 1.8.13 (Windows Store 1.8.42.0)
File Edit Sketch Tools Help
Nayan
trigger3count++;
//Serial.println(trigger3count);
if (trigger3count>=10){
angleChange = pow(pow(gx,2)+pow(gy,2)+pow(gz,2),0.5);
//delay(10);
Serial.println(angleChange);
if ((angleChange>=0) && (angleChange<=10)){ //if orientation changes remains between 0-10 degrees
fall=true; trigger3=false; trigger3count=0;
Serial.println(angleChange);
}
else{ //user regained normal orientation
trigger3=false; trigger3count=0;
Serial.println("TRIGGER 3 DEACTIVATED");
}
}
}
if (fall==true){ //in event of a fall detection
Serial.println("FALL DETECTED");
digitalWrite(11, LOW);
delay(20);
digitalWrite(11, HIGH);
fall=false;
// exit(1);
}
if (trigger2count>=6){ //allow 0.5s for orientation change
trigger2=false; trigger2count=0;
Serial.println("TRIGGER 2 DECACTIVATED");
Done Saving.
Arduino Uno on COM4
Type here to search
ENG
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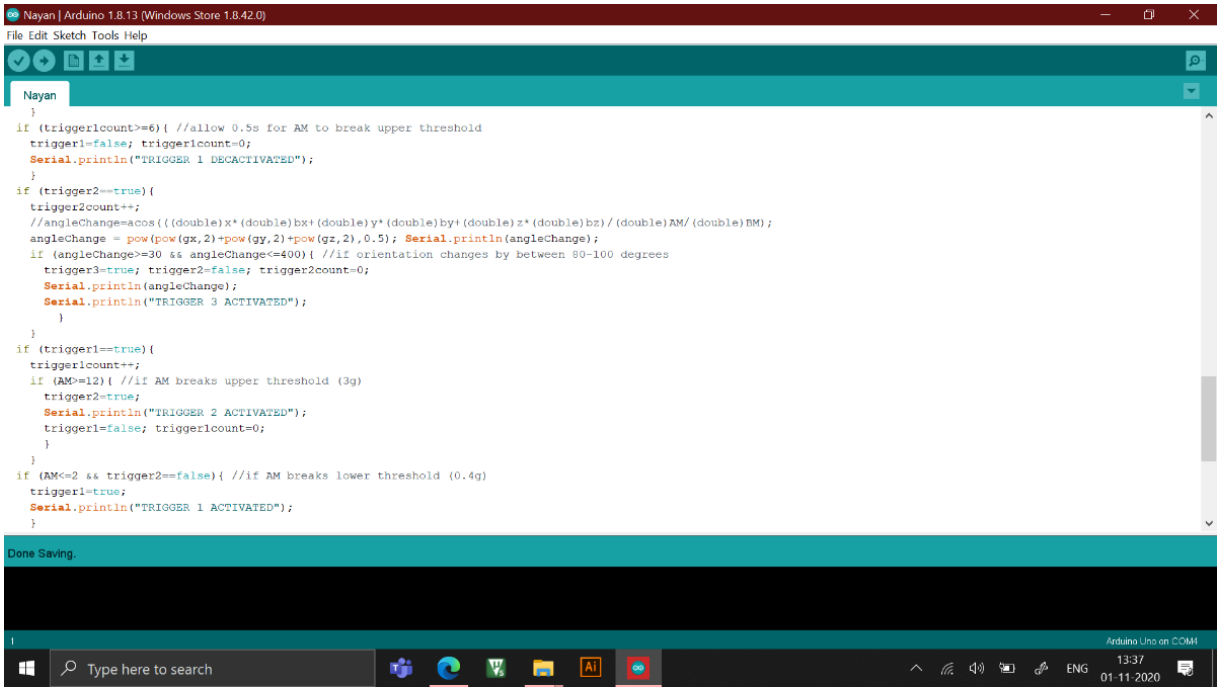
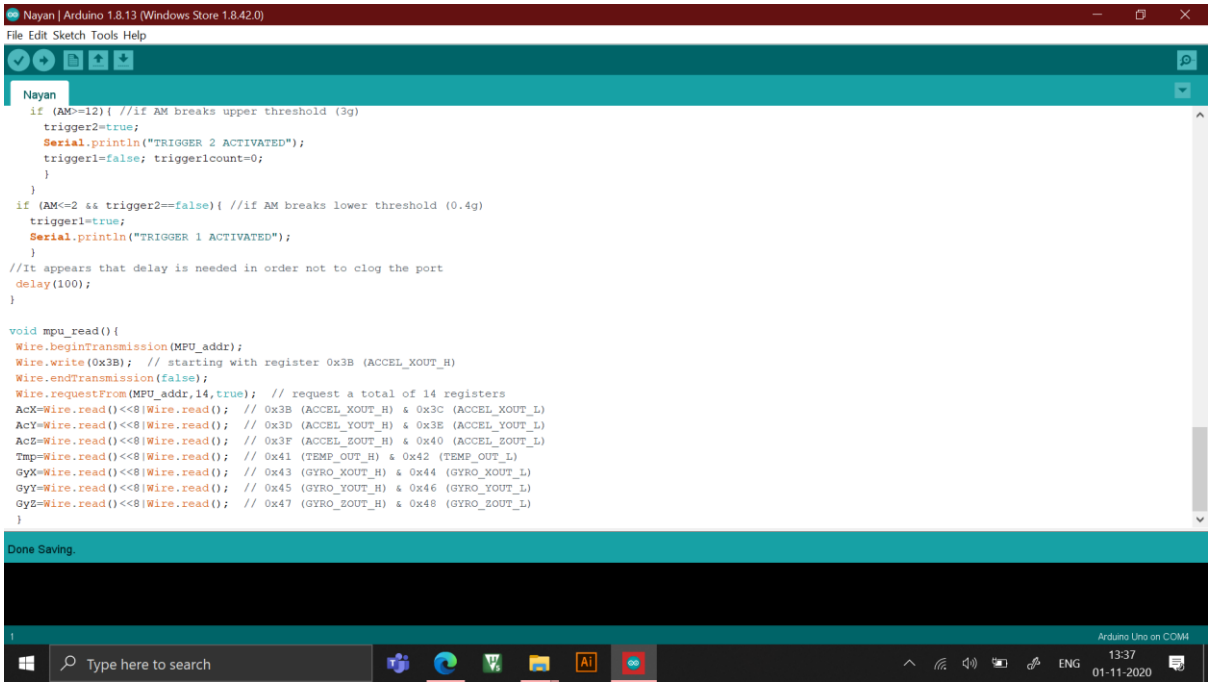
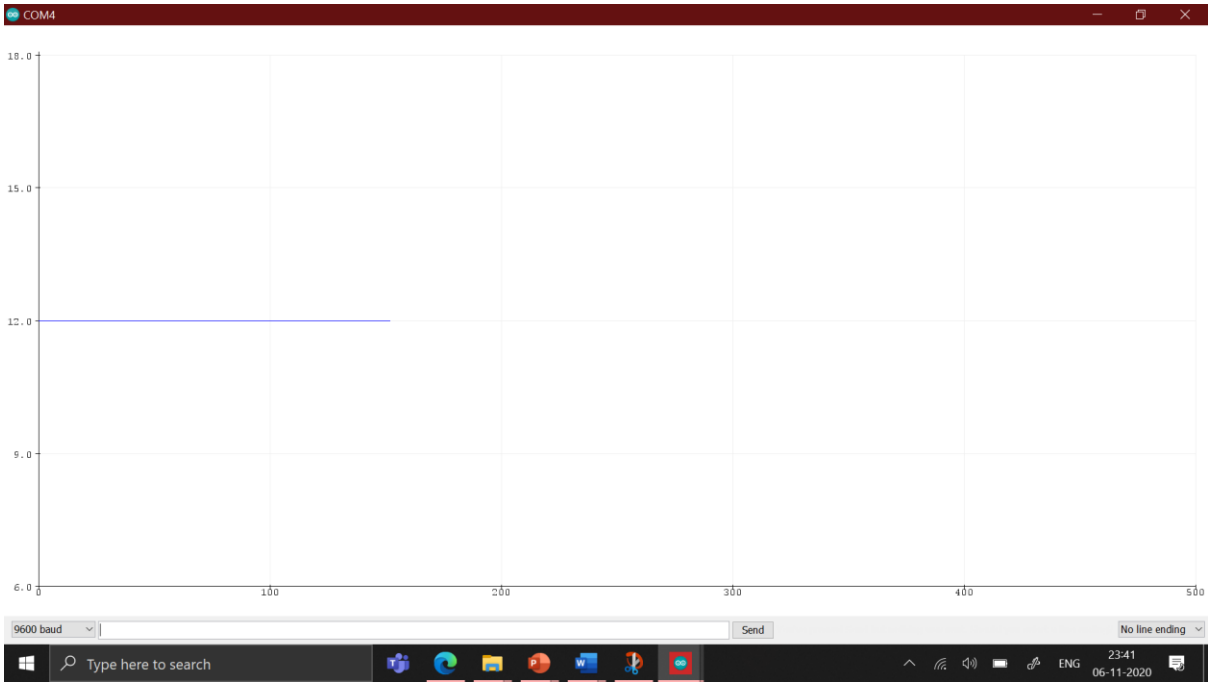
01-11-2020


Nayan | Arduino 1.8.13 (Windows Store 1.8.42.0)
File Edit Sketch Tools Help
Nayan
}
if (trigger1count>=6){ //allow 0.5s for AM to break upper threshold
trigger1=false; trigger1count=0;
Serial.println("TRIGGER 1 DECACTIVATED");
}
if (trigger2==true){
trigger2count++;
//angleChange=acos(((double)x*(double)bx+(double)y*(double)by+(double)z*(double)bz)/(double)AM/(double)BM);
angleChange = pow(pow(gx,2)+pow(gy,2)+pow(gz,2),0.5); Serial.println(angleChange);
if (angleChange>=30 && angleChange<=400){ //if orientation changes by between 80-100 degrees
trigger3=true; trigger2=false; trigger2count=0;
Serial.println(angleChange);
Serial.println("TRIGGER 3 ACTIVATED");
}
}
if (trigger1==true){
trigger1count++;
if (AM>=12){ //if AM breaks upper threshold (3g)
trigger2=true;
Serial.println("TRIGGER 2 ACTIVATED");
trigger1=false; trigger1count=0;
}
}
if (AM<=2 && trigger2==false){ //if AM breaks lower threshold (0.4g)
trigger1=true;
Serial.println("TRIGGER 1 ACTIVATED");
}
Done Saving.
Arduino Uno on COM4
Type here to search
ENG
13:37
01-11-2020

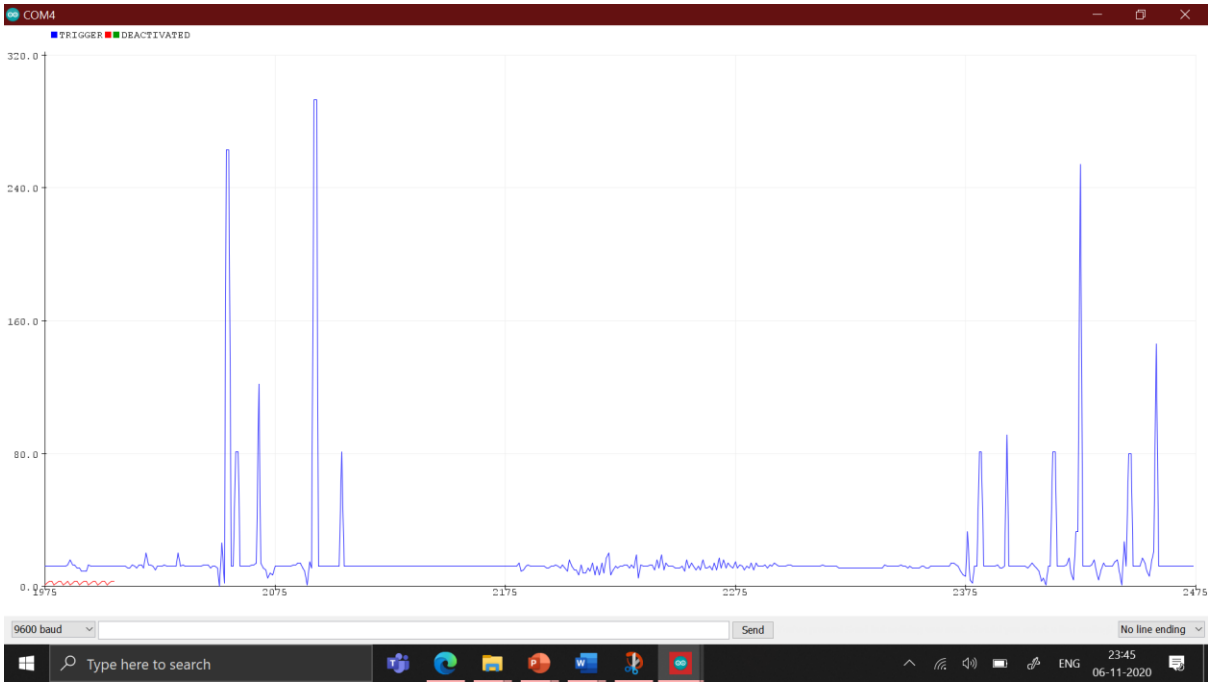


Simulation:

1. When there is no movement of the belt that is MPU6050 is kept still



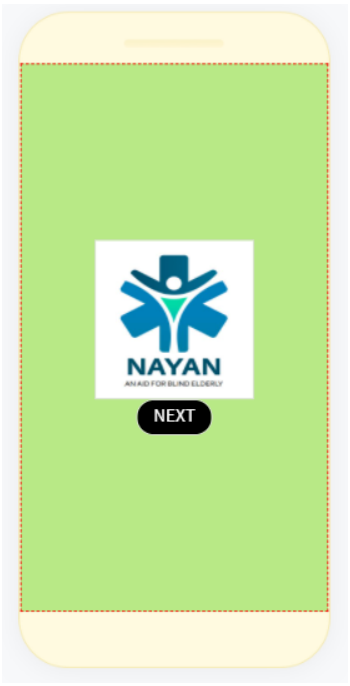
2. When a fall is detected the Graph goes to a high threshold value as opposed to normal movement

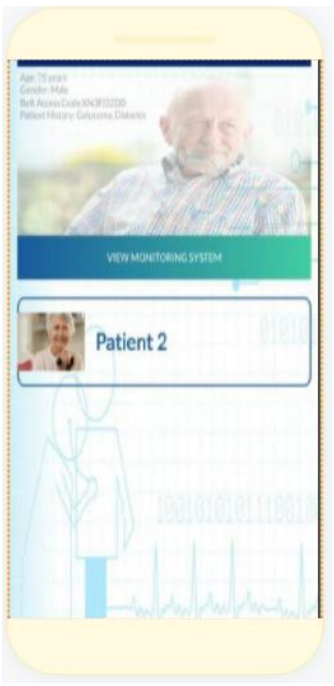


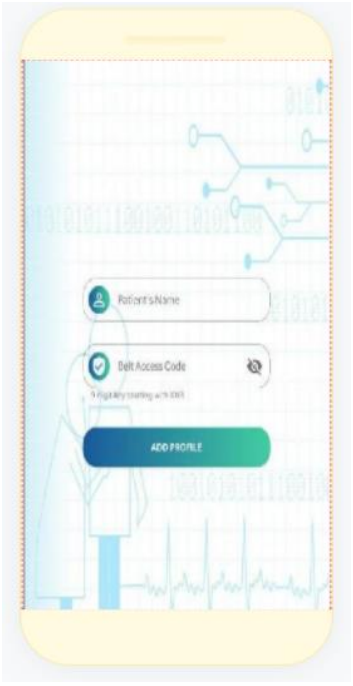
LINK FOR THE SIMULATION VIDEO:

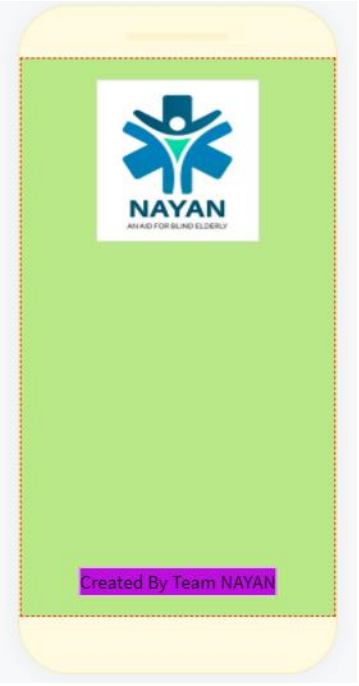
https://drive.google.com/file/d/1HO92Xj5cxPQZwzdE6rH52PMpUoS-lAjo/view?usp=sharing

App Prototype:







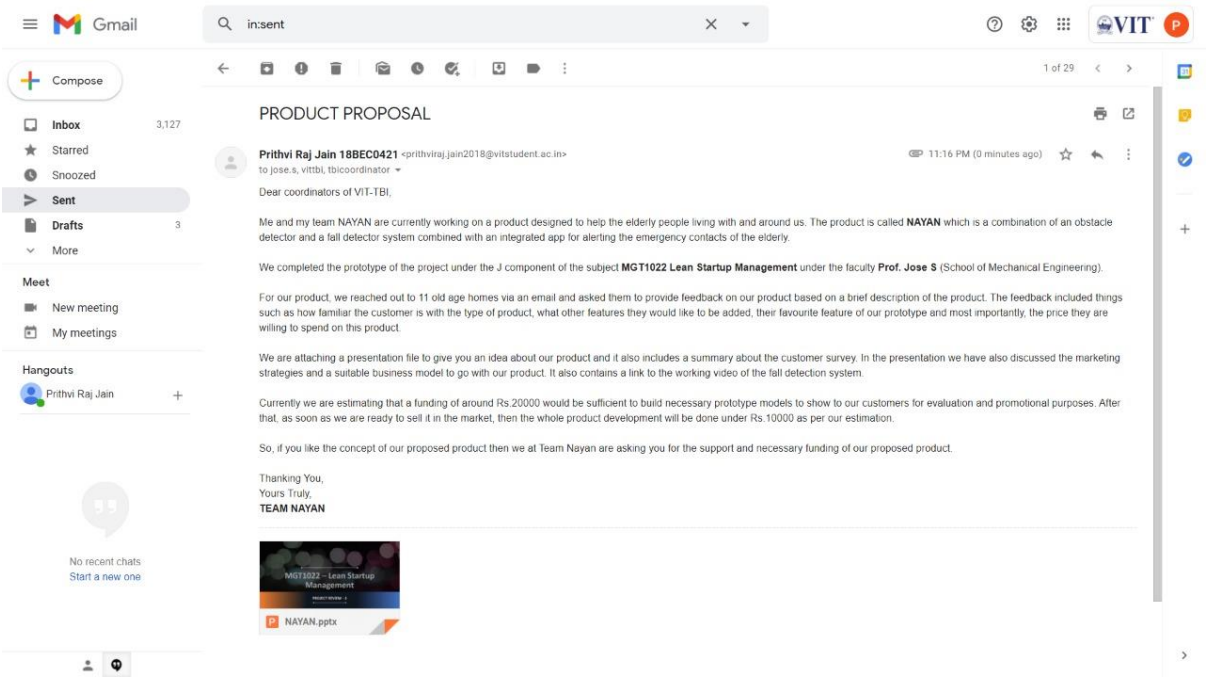


CONCLUSION

Envisioning the role of technology in transforming everyday life, we serve people who are suffering from cataract glaucoma. The problems faced by these patients puts their life in danger and at NAYAN, we work on technology to transform everyday life of these patients. We constantly strive to provide the best solutions for the problems faced by visually impaired patients.

For this purpose of Fall Detection, a 3D-axis accelerometer and Gyroscope (MPU6050) is used with Arduino Uno device wearable is used, which is responsible for collecting data from movements of elderly people in real-time. The results of experiments have shown high success rates in fall detection in terms of accuracy, precision and gain.

Screenshot of the email sent to TBI-VIT



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