

Security and Safety for elderly living alone

Design Degree Project (Stage I)

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Approval Sheet

The Interaction Design Project II entitled 'Security and safety for elderly living alone' by Mr. Shaswath Vaidyanathan, Roll No.08633804 is approved in partial fulfillment of the requirement for the Masters of Design degree in Interaction Design

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Abstract

The aim of this project is to design a security device, for elderly people, which would trigger a warning system and alert nearby neighbours and security guard for timely help. The purpose of the research is to find out the easiest way to communicate for the elderly in case he/she needs help.

To understand the problems faced by the elderly regarding security, the author has conducted several user studies and reviewed many newspaper articles and other literature survey. Design ideas were developed for individual problems faced and later collated and analyzed to develop final concepts.

The author puts forward a concept of Ubiquitous computing in the form of a wearable technology that provides him invisible security everywhere within the house at all times. This was proposed after conducting qualitative and quantitative experiments on the elderly using the wearable device. The early results show that this design proves to be useful and usable for the elderly.

Keywords: Ubiquitous computing, Wearable technology, Invisible security

Acknowledgements

I offer my sincere thanks to my guide Professor U.A. Athavankar for his constant support and guidance. I am grateful to have him as my mentor for his valuable teachings which will always help me in the future.

I am also thankful to Keyur Sorathia and my classmates at IDC for their suggestions and inputs that gave me a new direction of thinking and guided me throughout the project.

I also thank my professors Anirudha Joshi and Ravi Pooviah for their valuable inputs during different stages of the project which helped me greatly.

Finally, I am forever indebted to my family and friends for their support and encouragement.

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Introduction

India, as a country, is growing day by day both in economy and population. With the advent of better healthcare, the number of elderly people living in India has also increased significantly. According to the Indian National Human Development Report – 2001, every 10 out of 100 persons in the urban cities are in the age group of 60 years or above and they are the most vulnerable when it comes to crime. According to the Times of India, statistics on crime against elderly in India in urban cities show 42% of crime is due to abuse for property, 35% due to murder and 15% due to theft.

The vulnerability of elderly towards crime is reflected from the numbers but more than that, it is the fear towards crime itself that the elderly face. [1] The author stresses that the elderly tread their way carefully in the environment and more likely to perceive risks around them knowing about their vulnerability in strength. They take more precautions in their day to day life to avoid potential crime and hence are more likely to stay at home. [2]

Home security has become quite advanced to an extent where many state of the art sensors can detect possible intrusions in home by strangers and send out squealing alarms which can wake an entire neighborhood but they are targeted towards users who have gone out and when nobody is in the home. Considering the fact that most elderly live most of the time alone at home for a large part of the day, [2] it is essential

that a system exists in place where the elderly has the option of alerting the right people at the hour of need when they observe a suspicious activity or face a threat.

This project aims at presenting a solution that will help the elderly communicate to people nearest to them easily and effectively at times of need.

This thesis discusses the following,

- The current scenario on how crime takes place and the current security systems in place is understood from the back ground research.
- The ways and means of precautions taken by elderly and their problems faced towards security is recorded through the user studies.
- Design ideas and concepts are made from the conclusions drawn from background research.
- Experimentation and user testing is done with the design prototype to validate the research that's done

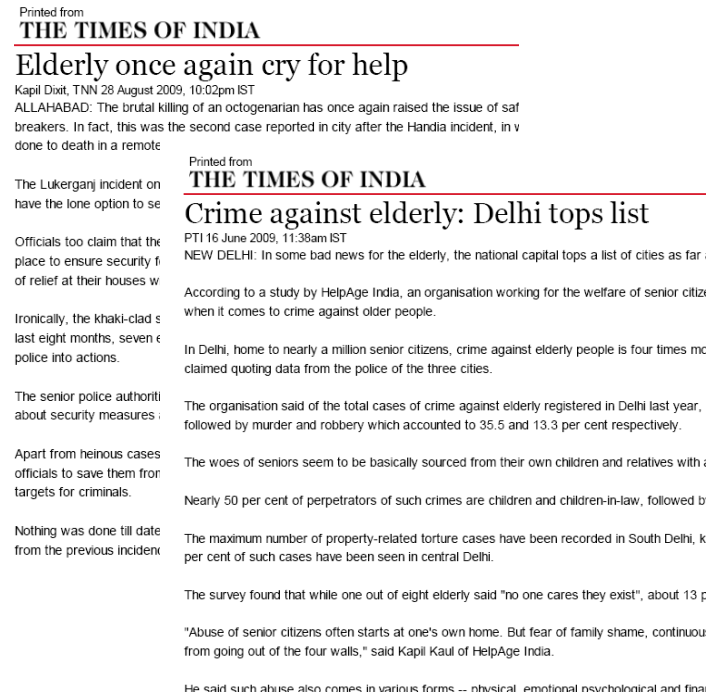


Fig. 1 Times of India articles on crime against elderly

Background Study

To understand the crime scenario, let us look at the crime statistics in India [3] which shows that 1 property crime takes place every 1 minute, 1 theft case takes place every 2 minutes and 1 burglary case takes place every 6 minutes in the urban cities. The pattern in which crime takes place in India is realized by going through the newspaper articles for the past few years and the most recurring scenarios are listed down. [4]

Findings from Newspaper articles:

- 1) **Family cook /servant** hatches plan with his friends and rob elderly.
- 2) **Burglars tie up elderly** by breaking open safety door with latch and later closing it while committing crime.
- 3) **Chain snatching** is active in summer because people don't wear shawls and sweaters to cover up.
- 4) **Thief dresses up smartly** and checks into the apartment as a regular inmate and breaks open locked door.
- 5) Although many foundations like Dignity Foundation and Help Age India help in creating awareness and providing Helpline facilities, **many elderly citizens still don't fall under their radar.**

Background Study

Now let us look at the current systems that are in place to prevent/detect crime.

Exploring Security systems

Case 1: Home monitoring systems

Advancement in science has brought about seamless interactions where a home can be monitored continuously and feedback sent to the user of the house but this works well if there is no one at home.

For instance here is a system provided by top security service providers (ADT) where motion sensors sense possible intrusions by someone and send a video feedback to a monitoring station which in turn alerts the house owner and the police.

Considering the same system in place and an elderly is inside the home and someone barges inside the door in the guise of a service man, the sensors won't get triggered unless the elderly presses the panic button which is only at a particular place and the video doesn't record that incident, even if it does it can be used only for post crime analysis.

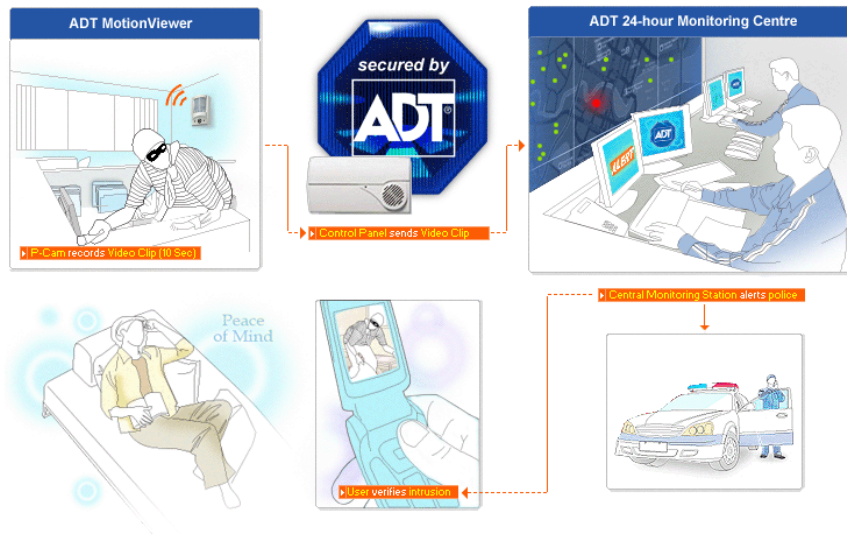


Fig.2 Wireless video intrusion detection
(Courtesy: ADT Security Services)

Background Study

Case 2: Video intercom door bell system

There are systems, like the video intercom security door bell, which help in monitoring who is at the door, right at the door step itself. It's up to the user to let the person in or not. There is a small video cam and an intercom placed outside the door for the authentication purpose. [5]

From the newspaper reports it is evident that many crimes take place by people who are known to the elderly, for instance the house maid or by the cook. In that case even if such a system exists it is of no use because the elderly can do nothing once the regulars are inside the home.

Case 3: Wearable Technology

Wearable computers has been widely used in health monitoring systems, for seamless acquisition of the condition of the internal organs of the body, but rarely being used as a security device. It finds its applications in very specific activities like the power button wrist alarm meant for people going out for a jog daily. They can alert their closed ones if they are in danger by pressing the button. [6]



Fig.3 Video intercom security door bell
(Courtesy: <http://yebang.net>)



Fig.4 Power button wrist alarm for joggers
(Courtesy: <http://hautegear.com>)

User Studies

It is important to understand the day to day activities of the elderly in order to find out the vulnerabilities that they may have in terms of personal security and hence user studies was carried out with 12 elderly citizens between the age group of 60 to 85.

The main focus of the user studies was to understand the different precautions that that elderly citizens employed to keep themselves and their belonging safe. Also their experiences in the state of emergency in the past were explored.

To understand their capabilities in memory, they were asked to recall at least 5 phone numbers that they know by heart to test who they would contact first in case of emergency.

The most frequently used artefacts that the elderly carry was also observed and listed out. Observations were also made when elderly went and opened the door to receive someone when they heard a bell and points were noted down on how they went about doing the same.



Fig.4 Elderly aged 60 and above



Fig.5 Apartments with security grills in mumbai

User Studies

Observations and Insights

Many observations are listed and some key insights were formed based on the contextual inquiry out of which the key findings are listed down below:

1. Only four out of 12 users knew these telephone numbers by heart:
 - a. Immediate neighbour's number
 - b. Nearby hospital/doctor's number
 - c. Other emergency numbers (police, fire etc.)
2. Cordless phone gets misplaced sometimes.
3. Seven out of 12 users use the mobile phone in which they have "necessary" contacts.

Insight 1: Since phone book is kept in the hall, in case of emergencies they have to always rush to the hall to call someone, as all contacts are not known by heart.

User Studies

4. Burglary has taken place in two of the user's homes.
 - a. People give keys to servants to water the plants when they are on a long trip.
 - b. Elderly citizens follow a regular routine when it comes to going on long trips like visiting temples and pilgrimages.

Insight 2: Elderly people being religious visit temples (long trips) and pilgrimages often, then there is a high chance of their house being burgled.

5. Only five out of the 12 user's apartment blocks have guards for 24 hours a day.
6. "Average age of security guards is 55 and above. They can't even scare a mouse".
7. Elderly citizen feel that all the night guards do is sleep in the night, so they are of no use.

Insight 3: Elderly citizens need a system to monitor the activity of the guards to trust them.



Fig.6 Safety Door

User Studies

8. Always the outer safety door is closed. Only the inner one is opened.
9. Safety door acts as one line of defense. Elderly citizens verify identity before letting anyone in.
10. Safety door in a way helps in holding newspapers, easy let through for letters etc. At the same time its grill blocks the view through the magic eye-hole.

Insight 4: Safety door is a must when living in an apartment.

11. All users have a good rapport with neighbors. They share the house key with them.
12. Elderly actively participate in bhajans, social services, activities etc. by which they get to know lots of people in the colony.
13. Eight out of 12 users know about Dignity foundation. 6 of them have the senior citizens card but feel it's too big and hence don't carry it.

Insight 5: Social contact with the neighbours and other people from the colony is very important for an elderly citizen.

User Studies

Breakdowns

- 1) Elderly feel young couples in their apartment don't mingle well with them.
- 2) They sometimes forget things – like removing key from the lock.
- 3) They long for affection from their children staying nearby but not visiting them.
- 4) Elderly need a contact-list which shares information that can be easily retrieved. Some of the information that they need are:
 - a) Nearby doctors number, hospital numbers, specialist doctors information
 - b) Names and telephone numbers of people residing in their apartment
 - c) Service people's numbers (plumber, carpenter etc.)

Additional research

Apart from conducting user studies with elderly citizens it is also important to understand the views that their neighbours have towards them. Hence few neighbours of elderly citizens were questioned on their take on providing help to the elderly citizen living next to them. The main observations were:

1. They are too busy with their daily routines although they do check up on elderly occasionally.
2. They are always ready to help elderly as they feel them as their own parents.

The different practices followed by the security guards in these apartments were also observed. In one interesting system, when someone comes into an apartment, the security guard dials the intercom of the concerned person and a video output of the front entrance is available for the user in a dedicated channel in their television set (Fig.7).



Fig.7 Video Monitoring through television

Design brief

The aim of this project is to design a security device, for elderly people, which would trigger a warning system and alert nearby neighbours and security guard for timely help.

The solution must satisfy these parameters,

Essential Parameters:

- 1) The device must be able to call for help within 5 seconds when activated.
- 2) The device must be easy to use in extreme circumstances (elderly being hit by someone, elderly falls down, elderly unable to see, elderly unable to move).
- 3) The device must be inconspicuous and must not reveal its identity of a security device.
- 4) The device must alert the elderly or the system about its existence.

Desirable Parameters:

- 1) The device must be always within the users reach.
- 2) The device must help in authenticating a person and monitoring his activities.
- 3) If it is a wearable device, then it is desirable that it is independent of a power source, to avoid being bulky.

Incentives:

- 1) The device must retain the cultural identity of the system that elderly live in; thereby making the elderly to use it regularly.

Concept 1

Based on the design brief set, some of the initial explorations of the design ideas that lead to the first concept are listed.

Key Insight 1:

Routine of the elderly is predictable and so guards and immediate neighbours can be more aware when they are not there.

Design Idea:

Neighbors can monitor elderly person's home once they are gone via a hall webcam with the help of a joystick. This gives the elderly person a surety that their home will be monitored when they have gone out on a vacation. The video cam will get automatically on each time a person enters the elderly person's home.

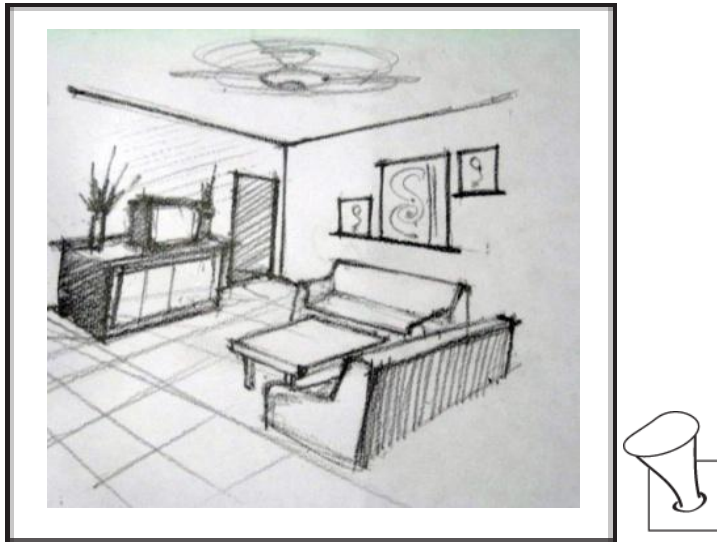


Fig.10 Inter hall video cam between neighbour's homes

Concept 1

Key Insight 2:

Immediate neighbours must be updated on who visits the elderly regularly and when they are going out.

Design Idea:

Neighbors can get a 5 to 10 sec preview on their TV or video interface when someone rings the bell on the elderly person's door. In case if it is an unknown guy, the neighbors' can enquire the person at the door step itself before the elderly lets him in.



Fig.11 Preview of person at door in the television set

Concept 1

Key Insight 3:

Elderly citizen feel the need for a separate sorted list of necessary contact numbers of nearby colony members.

Design Idea:

A list of all the contact numbers in the house display board. It can also have info on who has gone where, whose home is empty? It can also show up emergency numbers which can be speed dialed in case of an emergency.

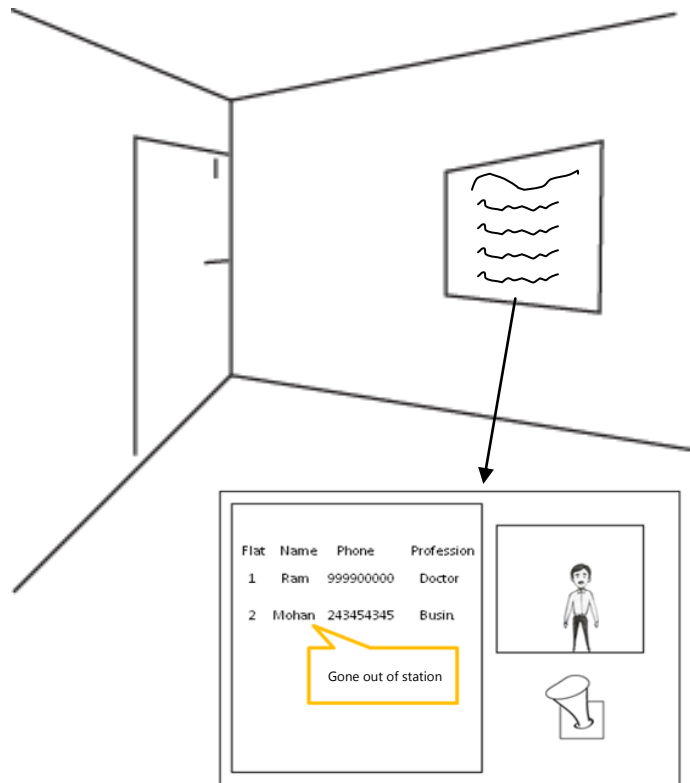


Fig.12 Digital house display board in every home

Concept 1

Key Insight 4:

Elderly feel the need for reassurance that they are safe.

Design Idea:

A webcam in the apartment reception can be used to watch the activities of the guard. Direct Live relay to the home is possible. The guard calls up the intercom of the elderly in case a person comes seeing the elderly and the elderly can confirm the identity of the person. The elderly on the other hand can monitor the movements of the guard always through the dedicated channel.

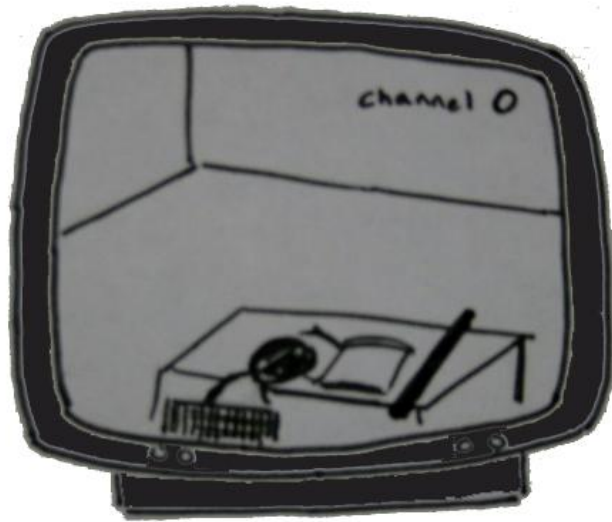


Fig.12 Dedicated channel in TV showing main entrance

Concept-1 | the digital home board

It is a culmination of the design ideas previously explored

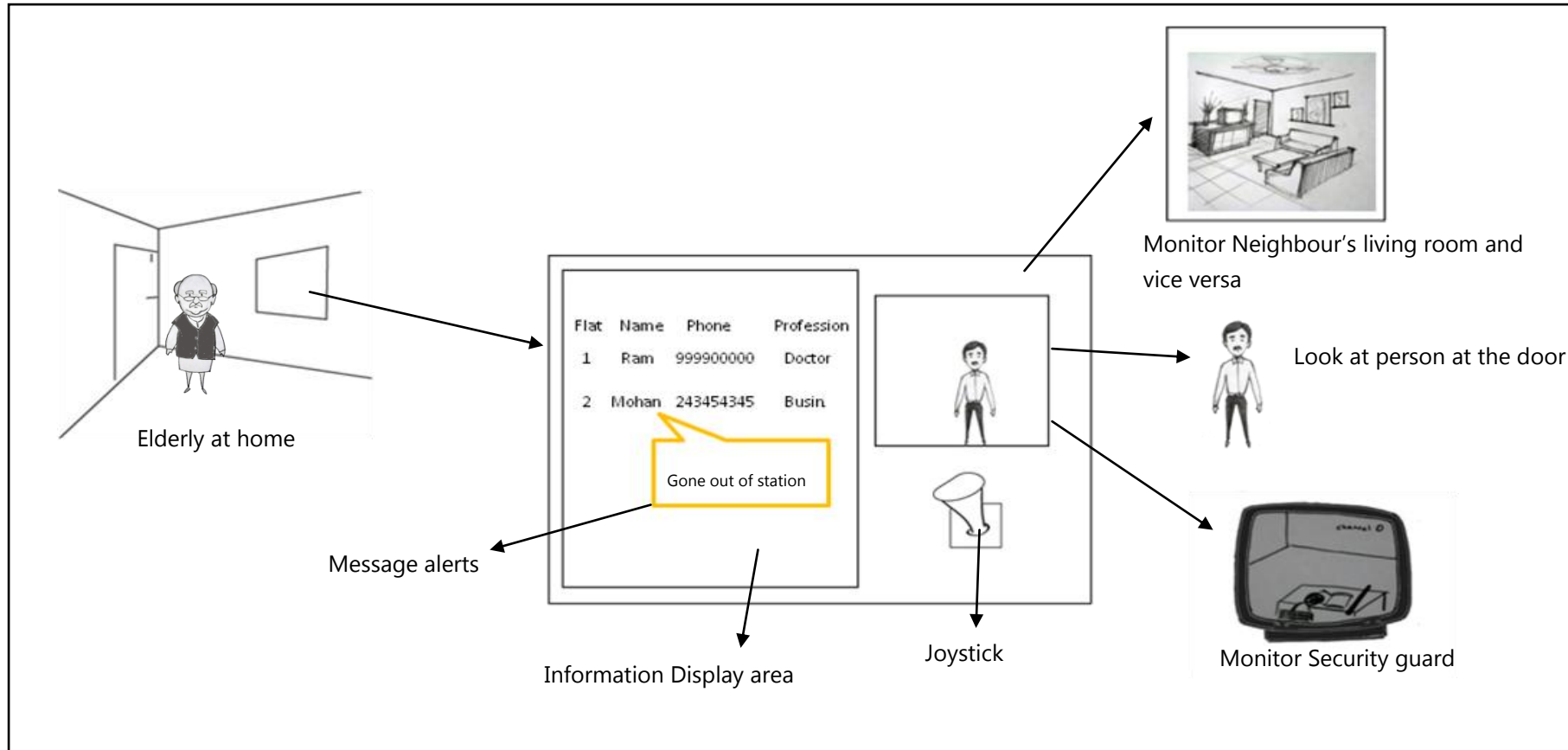


Fig.13 Digital Home board

Concept 2

Some of the initial explorations of the design ideas that lead to the second concept are listed.



Fig.14 Key chain with distress button

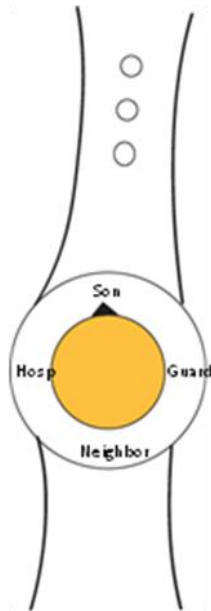


Fig.15 Watch with contact options

Key Insight 5:

A light weight device which can communicate quickly in times of help is the need for the elderly.

Design Idea:

A key chain can send out distress signal to apartment security guard. It can also help in locating the place where elderly is currently in (fig. 14).

There is a quick dial option in a strap able device. The user just has to rotate to the appropriate option and press the button (fig.15).

Concept 2

Key Insight 6:

The security device must be within elderly citizen reach at all times in case of danger or emergency

Design Idea:

A Voice recognition system in the elderly person's home can detect a unique phrase that is customized during its installation (e.g. Koi Bachao Mujhe). Whenever the elderly utters that particular phrase, the security guard can be alerted.

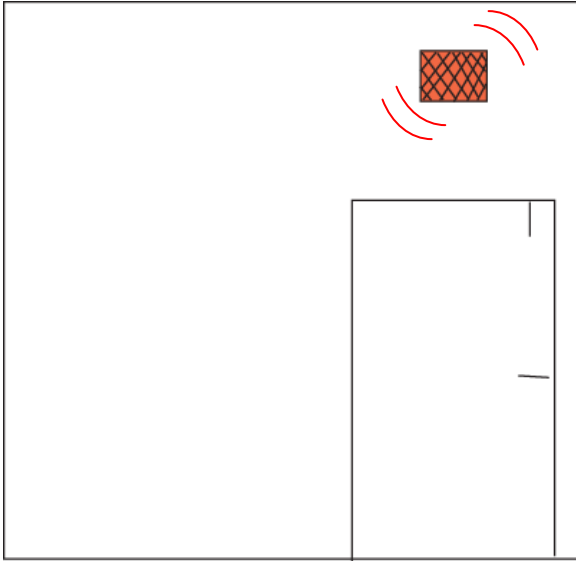


Fig.16 Voice recognition system

Concept 2

Key Insight 7:

The device must remind the elderly citizens, security related actions which they forget unintentionally

Design Idea:

A multipurpose key chain that has buttons can be handy for the elderly. It can have the name or symbol of the person to contact in each of the side buttons and the centre button can be used as an on/off button for the home's main door security system. In case the door is not locked properly or if someone enters the door, the centre button can give a beep and suitable action can be taken by the elderly.



Fig.17 Multipurpose keychain

Concept 2

Key Insight 8:

The identity of the person must be monitored and known at all times by the elderly/ guards in the apartment

Design Idea:

Door proximity sensors can activate respective colors on light lamps above the main door in the inside of a house (e.g. Yellow- same corridor, Orange- nearer to door, Red- fiddling with door)

Each time a new person comes at the apartment, the security can make them write their details on a digital tablet, and the webcam takes a snapshot of the new entrant. A RFID tag stores the unique serial number and it should be worn by the new entrant. They will get monitored whenever they are in the building.

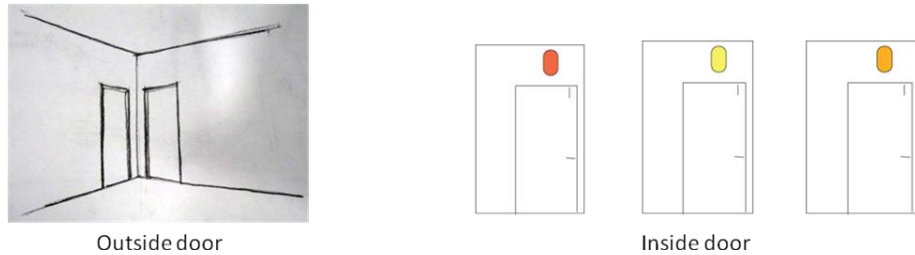


Fig.18 Glowing lamps inside main door



Fig.19 Security guard with digital tablet, RFID tag and a webcam

Concept -2 | Wearable Computing

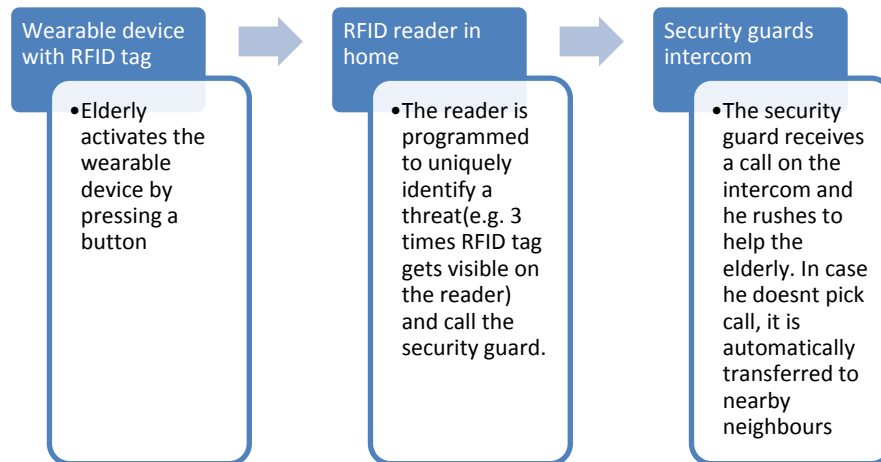


Fig.20 Process flow of Wearable Computing concept

The wearable device can be any of the elderly person's day to day products that he has been using for a long time or that he uses frequently. Since one single RFID reader installed in the home can uniquely identify upto 30 different tags, they can be embedded into almost all of the frequently used wearable products. In that way no matter which product the elderly is using, at any situation he can immediately call for help in case of an emergency. The interactions to call for help may vary from product to product depending on the ease of use of it.

The RFID tag is in the deactivated state by default. So it is not visible to the reader. When the elderly presses a button on the wearable device or depending on other kinds of interaction the RFID tag gets activated. Now the RFID reader detects the RFID presence and depending on the duration of the presence, it alerts the guard. The distress signal will be unique and hence will avoid false alarms to a large extent.

Concept -2 | Wearable Computing

Bangles/Kadi: The elderly may squeeze the bangle or kadi which in turn presses the button. When the elderly squeezes the bangle hard or when he falls down, the impact by which the kadi hits the ground activates the RFID tag.

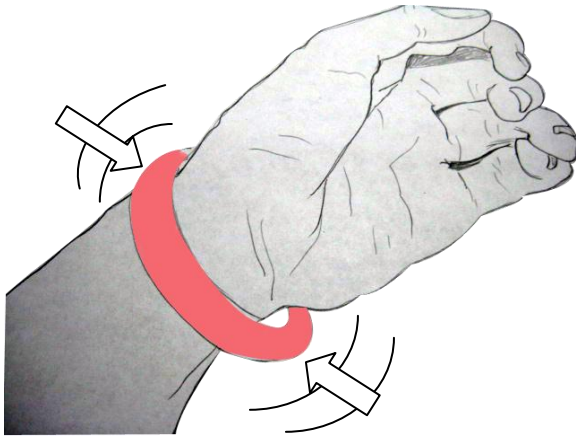


Fig.21 Bangles worn by females/ kadi worn by men

Earrings: The elderly may pinch the ear or press and pull down the button that is hidden on the back side of the ring to activate the button which in turn activates the RFID tag and makes it visible to the reader. The elderly can just act as if the ear is itching to perform this action.

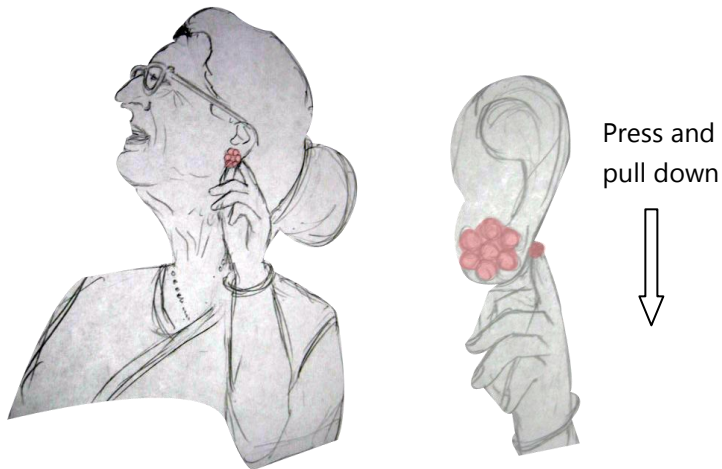


Fig.22 Earring with hidden button on back side

Concept -2 | Wearable Computing

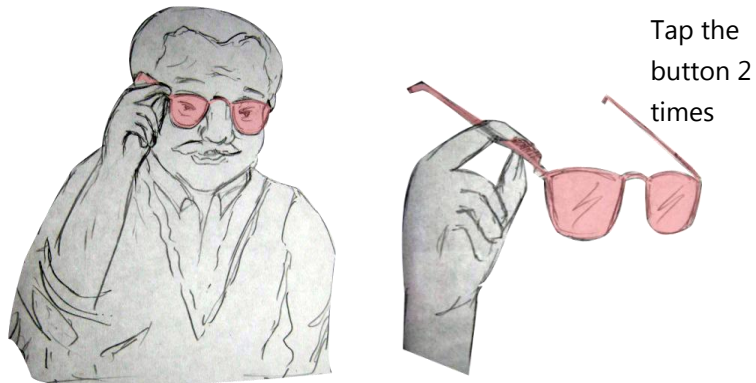


Fig.23 Spectacle with a button on the side

Spectacles: The elderly may tap the side button on the handle of the spectacle to activate the RFID tag. The elderly can just act as if he is adjusting the glasses to perform this action.

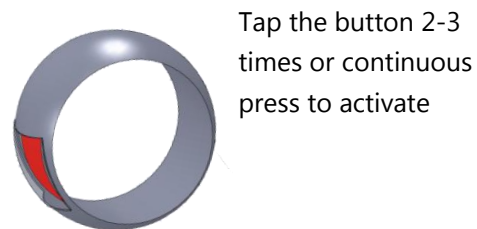


Fig.24 Ring with a button that can be pressed by the thumb of same hand

Ring: The elderly taps the button on the ring three times or just presses it continuously to activate the RFID tag. This action can be performed with utmost anonymity and hence is the best suited of all the wearable devices that the elderly can have.

Final Concept

From the two concepts that are mentioned, the first concept (digital home board) is helpful in knowing about the identity of a person who is at the door and at the same time helps the neighbors in monitoring his/her activities briefly, but there arise two major concerns:

- (-) Concern of privacy
- (-) If the person committing a crime is a known person (servant, cook, family member etc.) which is a high probability as seen from the statistics of crime (property, theft, abuse, murder etc.) against elderly in India (50% by own children, 27% by neighbors/servants etc.)

The second concept (wearable computing) explains a product that is always within the elderly persons reach. It is something that the elderly wears very frequently, may be every day. This is a very crucial reason in choosing the final product to be a wearable device because,

- (+) The elderly has total control (as it is easy to reach) on immediately calling out for help in case of a threat.
- (+) The elderly wears it every day which will help him in calling out for help from anywhere inside/outside the house.
- (+) As the product is personalized it becomes very hard to predict if it is a security related gadget unlike the digital display board.

Final Concept

The parameters that are considered to choose the best suited device amongst all wearable devices are:

- 1) Invisible Security (both in terms of looks and interaction with the product)
- 2) Easiest to reach
- 3) It must be easy to use in extreme circumstances
 - a. Elderly being hit by someone
 - b. Elderly falls down
 - c. Elderly unable to see
 - d. Elderly unable to move

And the best suited amongst all the wearable device is the **Ring** as it satisfies most of the essential and desirable qualities of the product brief mentioned earlier.

The technology that is used must be such that,

- 1) The wearable device doesn't require a power source
 - a. This will make the ring look like a ring
 - b. The ring no longer becomes bulky
 - c. Elderly need not worry about the charge going down
- 2) The system must uniquely identify the person who is in danger
- 3) The elderly must be in control of using the system

And the best suited amongst the technologies is the **Passive RFID tag**.

Final Concept | The RFID ring

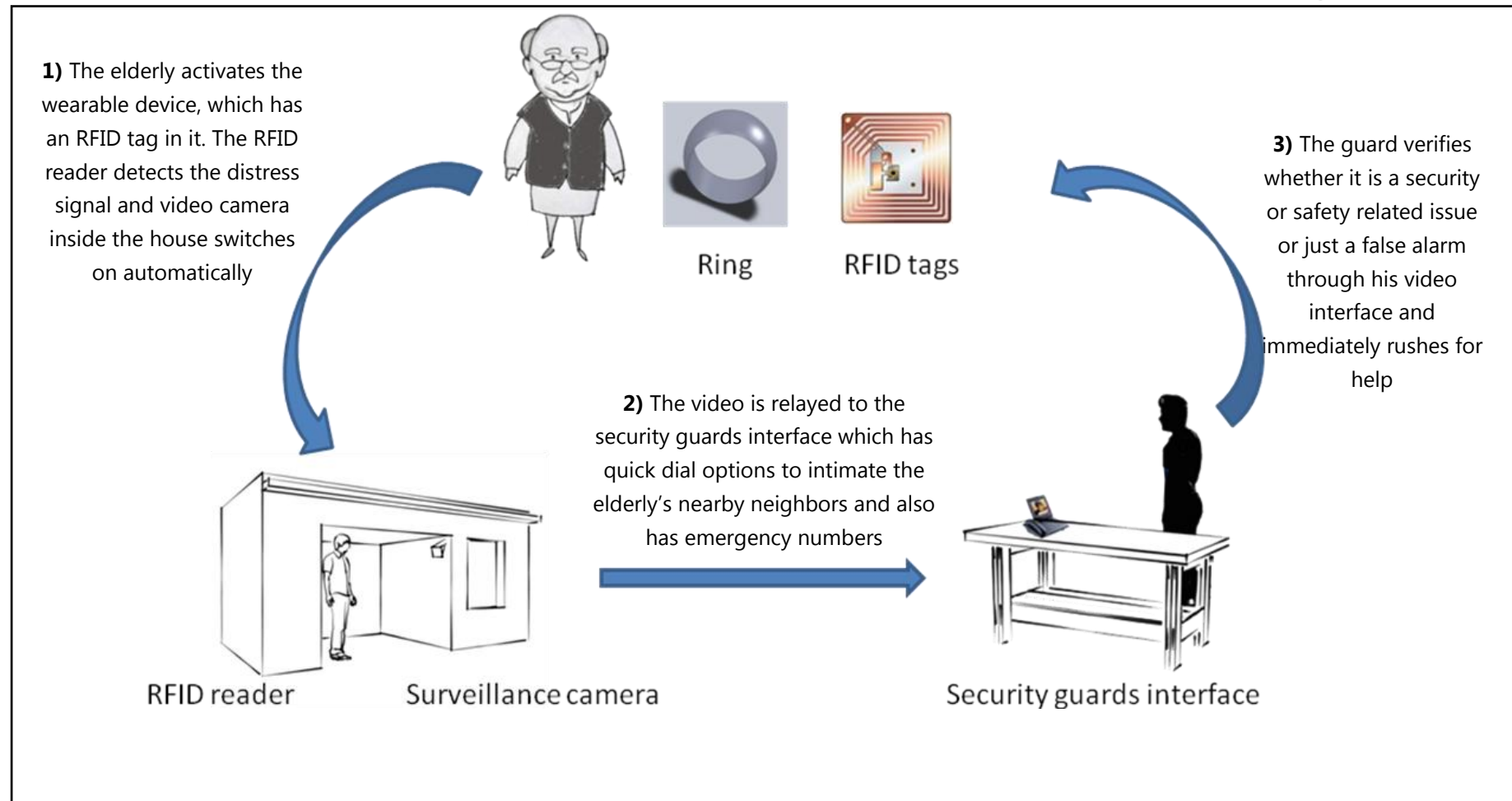
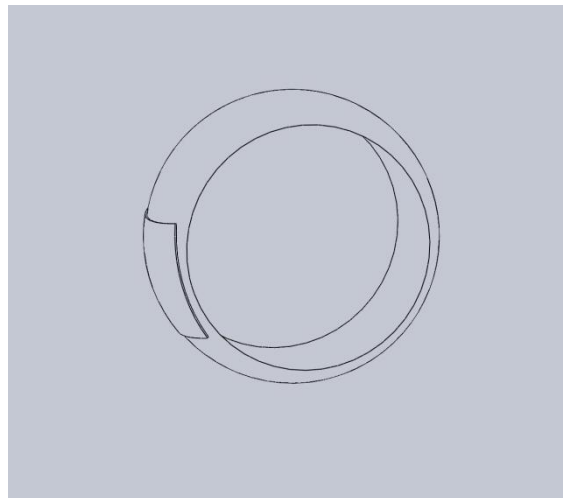
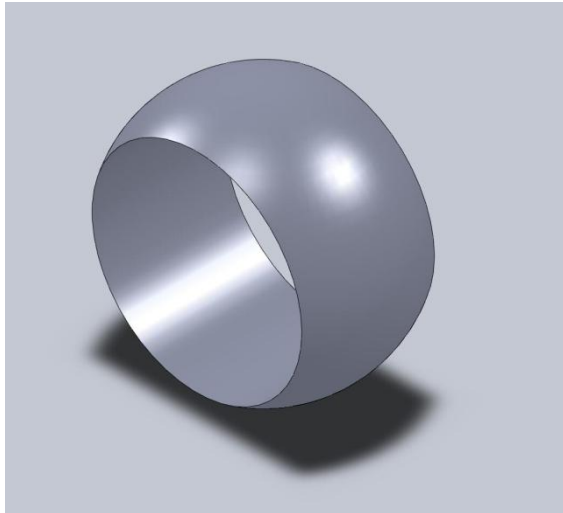


Fig.25 Working of the RFID ring concept



Final Concept | The RFID ring

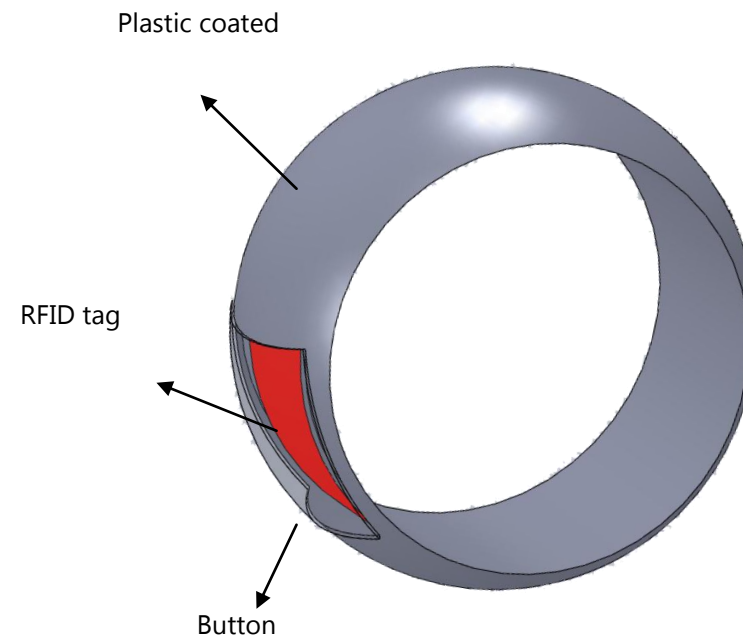


Fig.26 Components of the RFID ring

Final Concept | The RFID ring

The following parameters need to be looked for deciding the make of the ring.

- 1) Function
 - a. Interactions involved with the ring
- 2) Technology
 - a. The type of RFID tag to be embedded inside the ring
- 3) Mechanism
 - a. The button mechanism to be employed
- 4) Form
 - a. Size
 - b. Appearance
 - c. Material

The above mentioned parameters are validated and evaluated in the subsequent chapters.



Fig.27 Ring provides invisible security

Scenarios

The following scenarios validate the ease of interactions using the ring and the subsequent actions that take place.

Case-1

Elderly is unsure about a person who has come knocking at the door.

Invisible security –

1. Doesn't let the person know about the alert.
2. Doesn't embarrass a regular person like a courier service guy.
3. The elderly can alert guard of any suspicious moving guy (A person going up and down the stairs, standing in front of a door for a long time etc.).
4. The elderly can alert guard even while sitting and chatting with a person inside the house.

Scenarios

Case-2

Elderly is being tied up by robbers (either by unknown or known people).

Easiest to reach -

1. The ring is the easiest to reach especially in a scenario where the elderly is being tied up and is unable to move.
2. It is difficult to forcefully pull out the ring, by the intruder unlike a necklace or keychain or watch.
3. In case the intruder tries to pull out the ring, the button will get pressed, as it is difficult to remove a ring from a finger. So the force applied will cause the button to be pressed.



Fig.28 Ring is the easiest to reach

Scenarios

Case-3

Elderly is being threatened by people inside his home (for money, property etc..)

Easiest to activate -

1. The ring is easiest to activate especially in an unexpected scenario.
2. Recording of identity is helpful only to a certain extent, if the servant (or cook) decide to commit the crime; the elderly has to save himself.



Fig.29 Ring is the easiest to communicate

Scenarios

Case-4

Elderly feels drowsy and is unable to see because of being hit by an intruder or due to health reasons.

Easily reachable when elderly is temporarily disabled

1. The ring is helpful especially in a state of total confusion where the elderly doesn't know about what is happening around.
2. In that state it is best to hold on to a device that is very near to you and activate it (or press or hold it tightly, squeeze etc.).
In this case the RFID reader will detect the presence of the ring continuously for 2-3 seconds and then alert the guard.



Fig.30 Scenario where elderly is unable to see

Scenarios

Case-5

Elderly slips and falls down, unable to move. Distress signal automatically unbolts the front door and will allow in any person who has an RFID tag (recognized by the reader) with him

Can be combined with other forms of electronic safety devices

1. The RFID reader can be programmed to open the front door, and also alert the security guard etc.
2. Other systems like the heart monitoring systems can be synched with the ring to help in sending out an alert signal to the security guard even in the case the elderly forgets to press the button. For instance due to the sudden rise in the heartbeat the heart monitoring system may cause the ring to vibrate which will remind the elderly of the button.



Fig.31 Scenario where elderly is unable to move

Technology

The wearable device must be able to communicate to the receiver at any time from any place inside the home and at any position it is held.

RF transmitter and receiver

One way to do that is to have a RF (Radio Frequency) transmitter. It makes use of radio frequency waves to transmit the signal when the button is pressed. It requires a battery for power and an antenna for transmitting the signal. Although the technology is cost effective, it has its own drawbacks.

- 1) The elderly has to change the battery if it is out of charge.
- 2) There must be some feedback (e.g. visual indication) in the wearable device to let the elderly know of the battery charge.
- 3) The ring, in this case will be bulky and hence will give away its identity of a security device.

Technology

RFID (Radio Frequency and Identification) Tags

The term RFID is used to describe various technologies that use radio waves to automatically identify people or objects. RFID does not rely on the line-of-sight reading that bar code scanning requires to work.

RFID systems are of two types- active and passive. Active systems work similarly to the radio frequency transmitter and receiver mentioned before. Passive RFID tags do not have their own source of energy. The reader provides the required power through an antenna attached to it. This energizing is enough for the tag to return the information stored in its own memory in form of radio waves to the energizing device. The reader then processes the signs and sends them directly or indirectly to the supervising program which send signal to the security guard in the form of an intercom ring or on a video interface.

Passive Low Frequency tags (125-135 kHz) can be read up to 30 cm away, High Frequency tags (13.56 MHz) up to 3 m away, Ultra High Frequency tags (2.45 GHz) up to 7 m away, and active tags up to 100 m away or more. [7]

The different sizes of the RFID tags are shown (fig. 32) according to which different forms of the rings can be explored (fig.33).



Fig.32 Sizes of RFID tags
(Courtesy: <http://www.nearfield.org>)



Fig.33 RFID bracelets of varying sizes
(Courtesy: <http://www.rfid-in-china.com>)

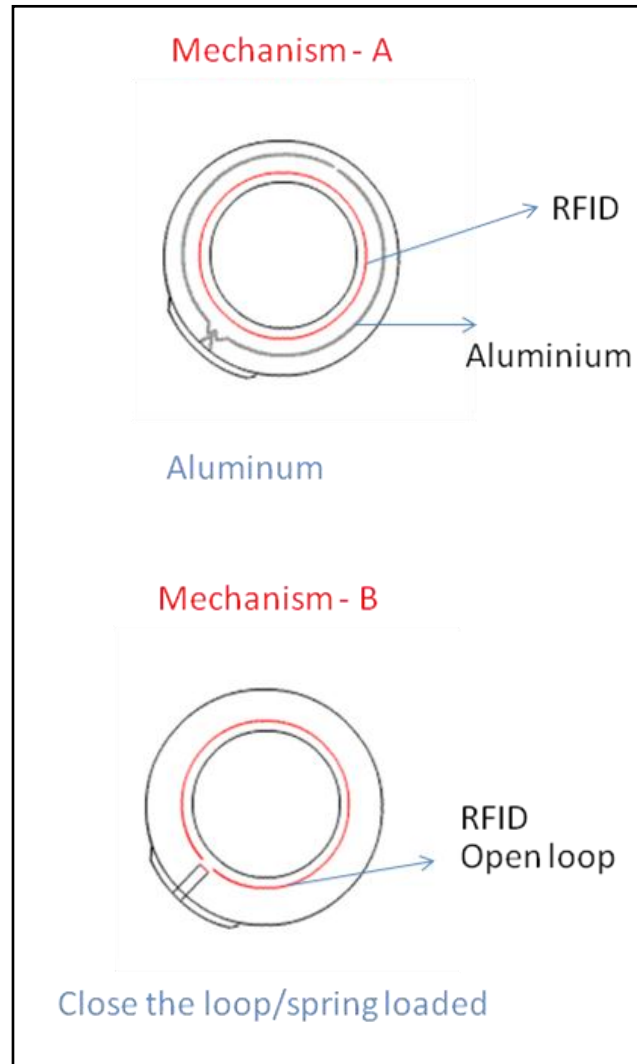


Fig.34 Mechanisms inside the ring

Mechanism

IF the RFID tag is enclosed within the ring, the following mechanisms may be used.

Mechanism A: A thin layer of aluminium surrounds the RFID tag. As metals rebound radio waves, by default the ring will be in the de activated state. When the button is pressed, the aluminium layer opens up allowing the radio frequency waves to get in. A similar kind of mechanism is demonstrated in the Tag-con where a multiple RFID tags are manipulated by pressing a button, by which the distance between the tag and the aluminium foil comes apart and the tag gets activated. [8]

Mechanism B: A part of the circuit of the RFID tag is kept open and when the button is pressed it completes the circuit and gets activated. A similar kind of a mechanism is demonstrated in the Pressure-Activated RFID Tags for Mobile Phones where a cardholder may activate the card by applying external pressure to the surface of the card at a predetermined position closing the switch contacts which open again automatically when pressure is removed. This is keeping in mind the security and privacy of the elderly. [9]



Fig.35 (Clockwise from top) User1, 3v battery, normal button, countersunk button, led

Evaluation

A certain set of qualitative and quantitative experiments were conducted to ascertain the type of interactions that is being associated with the ring. Two types of rings were used in this case – 1) Button as an extrusion outside the ring and 2) Button is countersunk on the surface of the ring. A LED (light emitting diode) was connected to the ring and a 3 volt micro lithium cell. So each time the button gets pressed a visual confirmation is got from the LED glow that is strapped to the user's wrist for experimentation.

Experiment 1: Which ring is more comfortable for the user?

For this experiment the first task was to ask the user to wear the ring in each of his fingers and look at the most comfortable finger for wearing the ring

Observation: The ring finger proved to be the easiest to reach and press for the elderly

The second task was to ask the elderly to close their eyes and press the button and feel the feedback of the button being pressed

Observation: Both types of buttons were easily pressed and the feedback was felt in the form of a click.

Evaluation

Experiment 2: How often the ring gets pressed while performing daily tasks?

For this experiment, the elderly was asked to perform these set of tasks:

1. Lifting a bag with weight inside
2. Holding the chair handle for grip when getting up
3. Taking support of the wall while walking
4. Shaking hands with another person
5. Clutching the fingers tightly

It was observed how many times the LED glows in performing these tasks

Observation: It was clear that the countersunk button was more effective in not being pressed while performing these activities which make it more reliable against false alarms.

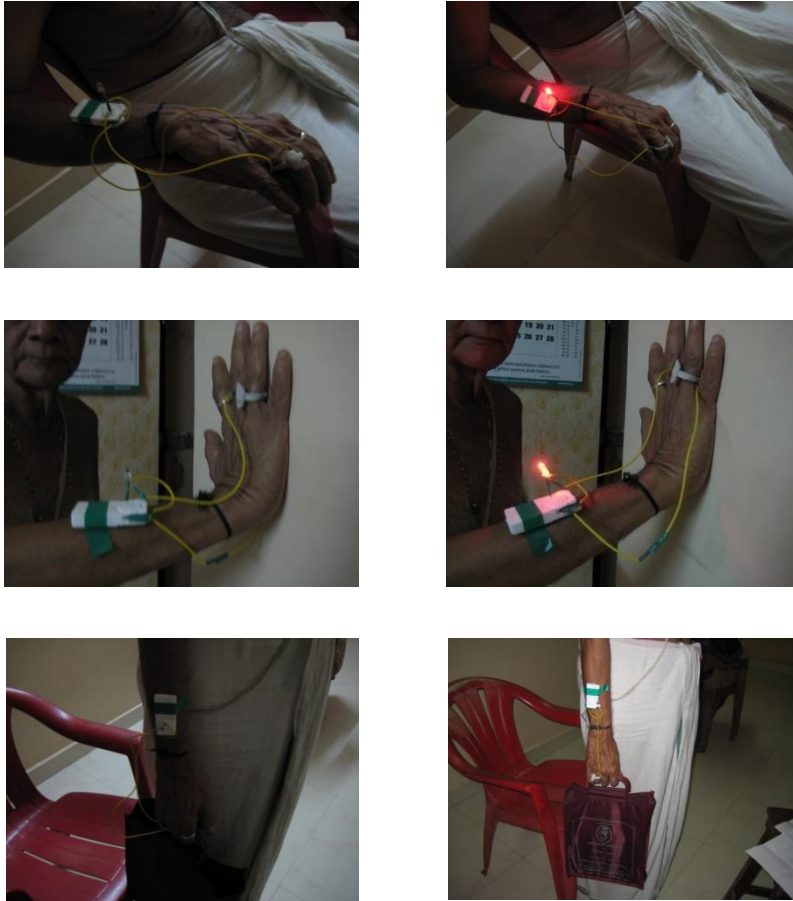


Fig.36 Set of experiments conducted on (left) countersunk and (right) normal button type



Fig.37 Support holding experiment conducted on user 2 with the normal button type

Evaluation

Experiment 3: Which ring gets pressed unintentionally while performing user specific activities?

The elderly was asked to perform activities that he usually does with his own ring like:

1. Playing with the ring: Knocking it on the chair
2. Rotating the ring

Observation: Again the countersunk button proves to be more effective in not being pressed while playing with the ring unconsciously.

Conclusion: The elderly felt that the extruded button (button A) was easy to press and they could feel it being pressed better but apart from that in all other scenarios shown above the countersunk button served better purpose of avoiding the false alarm.

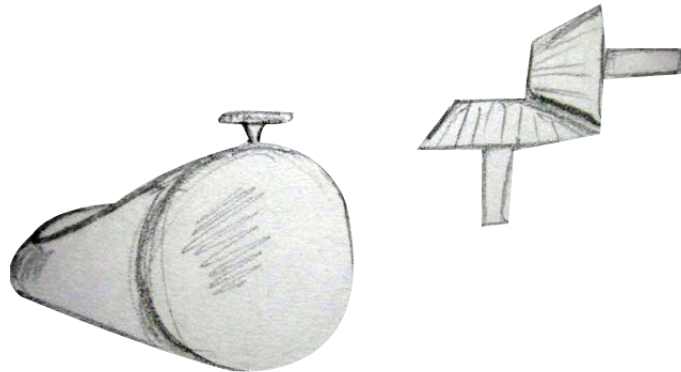


Fig.38 Mechanism to adjust the diameter of the ring using bevel gears

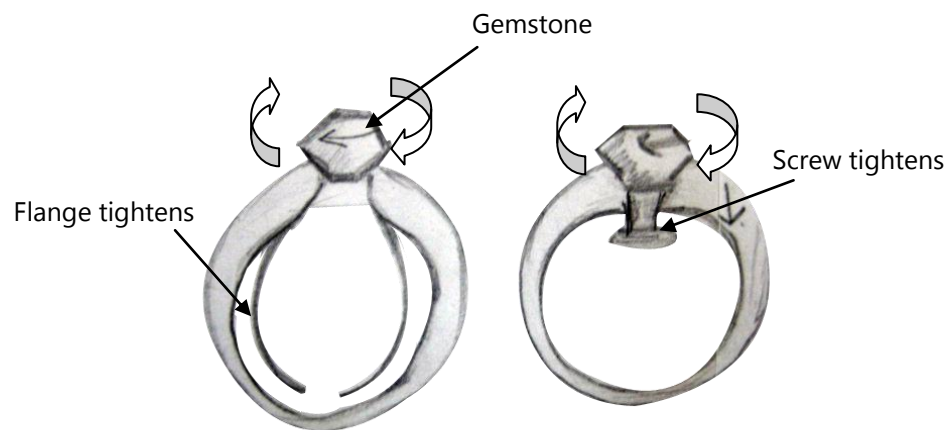


Fig.39 Mechanism to adjust the diameter of the ring using flanges (left) and screw (right)

Form Explorations

Apart from the type of the button to be used there are other design considerations that needs to be made like

1. Size
2. Appearance
3. Material

1) Size:

The diameter of the ring must be suitable to be worn in any finger of the user.

- 1) The design can be like the working of a belt. By turning it clockwise it tightens and anticlockwise makes it to open more. It can be locked in place by a slider.
- 2) The gem stone can act like a tightner/screw to tighten to the required diameter by the user
- 3) The ring can be custom made for the required diameter by the jewelry maker

2) Appearance:

The appearance of the ring must not give away its identity, at the same time it must not attract the opposite persons attention.

- 1) The ring can be made of copper (on the lower half) and copper looking material (plastic with appearance of copper) on the upper half. As some people prefer drinking water from copper vessels for its health added reasons, they can use it for the same purpose

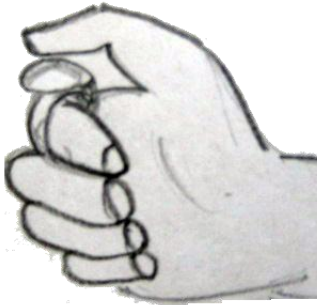


Fig.40 Button is on the gemstone itself and the ring is put only in the index finger

Form Explorations

while eating with right hand. And since copper gives the notion of a cheap material, it won't be stolen.

- 2) The ring gives the impression of a health aid device for the elderly being black in color. This would prevent someone from trying to steal it for their own benefit

3) Material:

The Material must be sturdy enough that it doesn't break or bend when user hits an object by mistake with force or falls down etc. At the same time only a certain amount of conductive material can be used to make the ring keeping in mind the rebound nature of the radio frequency waves by metal.

- 1) The ring can be made of plastic which doesn't wear or wash out when in contact with water or other consumable liquids.
- 2) The ring can be made entirely of copper if it is proved that the RFID tag within the ring can still be detected when activated by the button.

Form Explorations

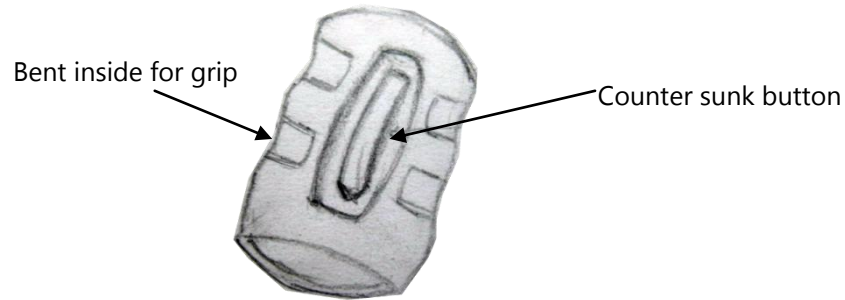


Fig.41 Broad ring with countersunk button

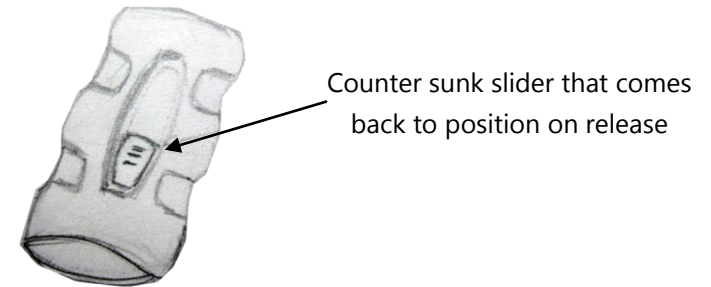


Fig.42 Broad ring with spring loaded slider

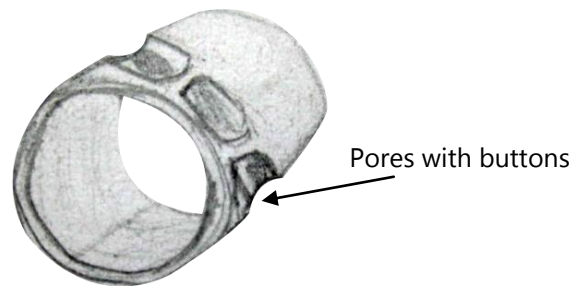


Fig.43 Broad ring with buttons all around the circumference

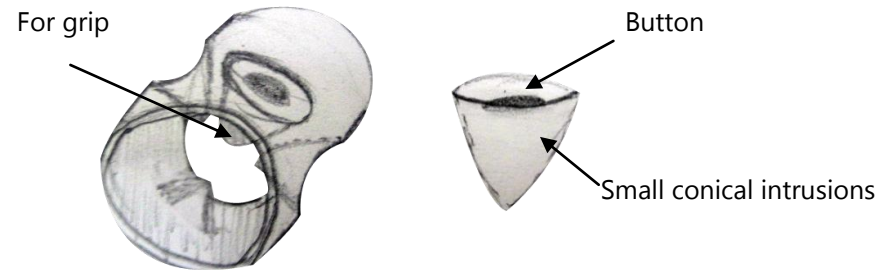


Fig.44 Broad ring with countersunk buttons in form of cone extrusions on the inside

Form Explorations

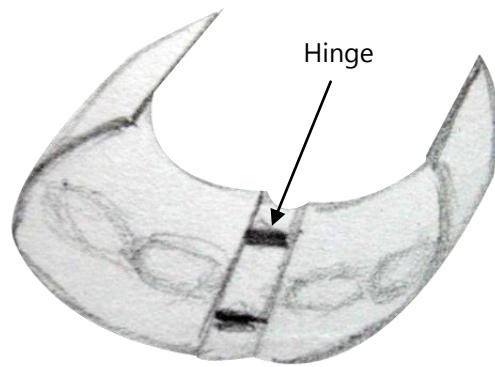


Fig.45 Hinge type ring for easy fit

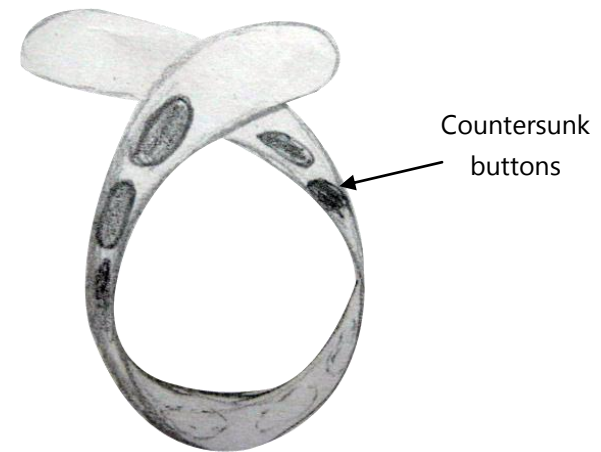


Fig.46 Shapeable ring using flexible materials

Form Explorations



Tightening of the ring



Ring must not rotate, so that the position of the button doesn't change

Attributes of the ring



Rings with health benefits



Rings with Devotional symbols



Rings with cheap and simple look



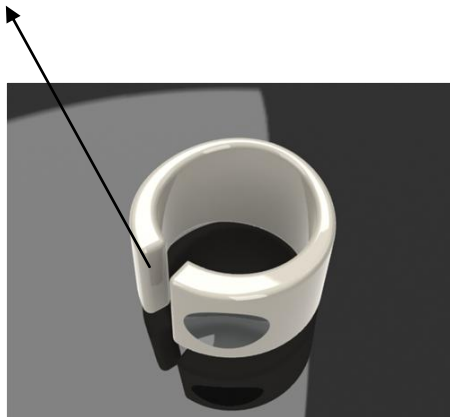
Rings with superstitious beliefs



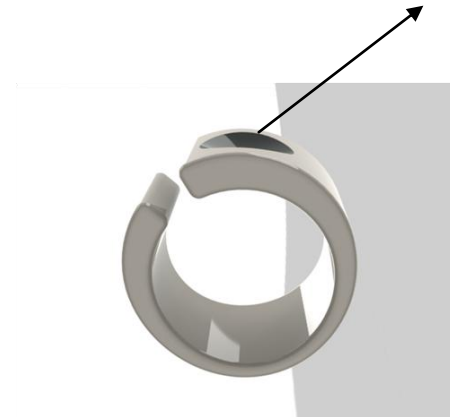
Rings which provoke memories

Final Design

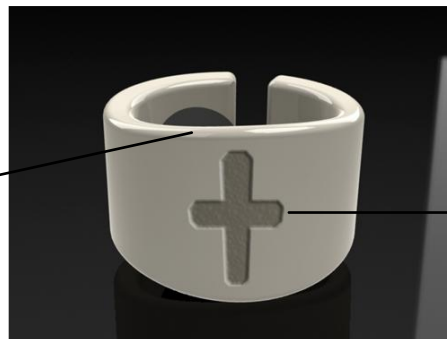
Open ring for tightening of the ring



Countersunk button



Shape to direct the ring into correct position



Religious symbol to make it look like any other normal ring

Fig.47 Final ring

Future works

- 1) The range of the RFID tag can be significantly increased by harnessing energy of the radio frequency waves continuously emitted by the RFID reader. This in turn will allow a single reader to be placed in one floor and it can still detect each and every inmate of the houses in that particular floor uniquely if they are wearing a tag, thereby cutting down the cost to great extent and at the same time increasing the scope of detection of the tag even in corridors and staircases.
- 2) As a single RFID reader can uniquely identify more than 30 different tags, RFID tags can be placed in doors and windows of the house as well. When the elderly presses the panic button, the reader can be programmed to unlock the bolt of the front door which will allow help people to reach for help easily.
- 3) The ring can be combined with heart monitoring system which can monitor the heart rate at all times. If threat is detected (by sudden increase of heart beats which is different from gradual increase of heartbeat) the ring can vibrate which will make the elderly feel its presence and remind him to press the panic button.
- 4) Since the elderly will be wearing a wearable device with RFID in it, it can be used for contactless payments also if that facility is provided in public places. That helps in stopping theft from happening as the elderly won't be carrying physical cash.

References

1. **Skogan, Wesley.** *The Fear of Crime Among the Elderly.* s.l. : U.S. Department of Justice., 1978.
2. **Brogden M, Nijhar P.** *Crime, abuse and the elderly.* UK : Willan, Devon, 2000.
3. **Crime clock, Ministry of Home Affairs.** [Online] 2004.
4. **TimesofIndia.** *indiatimes.* [Online] 2001 - 2009. [Cited: August 14, 2009.] www.indiatimes.com/timesofindiaarchive.htm.
5. **Swann.** Products: view: 389. *swannsecurity Web site.* [Online] 2008. <http://www.swannsecurity.com/s/products/view/?product=389>.
6. **Doberman.** *hautegear.* [Online] 2005. <http://hautegear.com/wearables/category/security/>
7. *A Platform for RFID Security and Privacy Administration.* **Melanie R. Rieback, Georgi N. Gaydadjiev, Bruno Crispo, Rutger F. H. Hofman, and Andrew S. Tanenbaum.** Washington, DC : s.n., 2006. Proceedings of LISA '06. pp. 89-102.
8. **Yoshida, R and Yasumura, M.** *Tag-con: a real object interface using multiple manipulable rfid tags.* 2007.
9. *Stick, Click n' Call: Self-adhesive Pressure-Activated RFID Tags for Mobile Phones.* **Hemmert, Fabian, et al.** Cambridge, UK : ACM, 2009. Proceedings of the Third International Conference on Tangible and Embedded Interaction (TEI'09).