

CENTRE OF EXCELLENCE

IN

INDUSTRIAL AND PRODUCT DESIGN

(under TEQIP-II: Subcomponent 1.2.1)



**PEC UNIVERSITY OF TECHNOLOGY,
CHANDIGARH**

- **Director** : Prof. Manoj K Arora
(PEC University of Technology)
- **Co-ordinator** : Prof. Parveen Kalra
(Production Engineering Department)
- **Co-coordinators** : Dr. Neelam R Prakash
(Electronics Engineering Deptt.)
Dr. Sanjeev Kumar
(Mechanical Engineering Deptt.)



Vision

CoE - I&PD will establish itself as a global resource centre in the areas of Industrial and Product design



Mission

CoE-I&PD will be offering solutions in the areas of ergonomics and design to address the needs of society, industry and medical organizations

CoE-I&PD will be a preferred destination for industry, research and medical organizations to locate the best professional talent, proficient in the areas of ergonomics and design



Thematic Area(s)

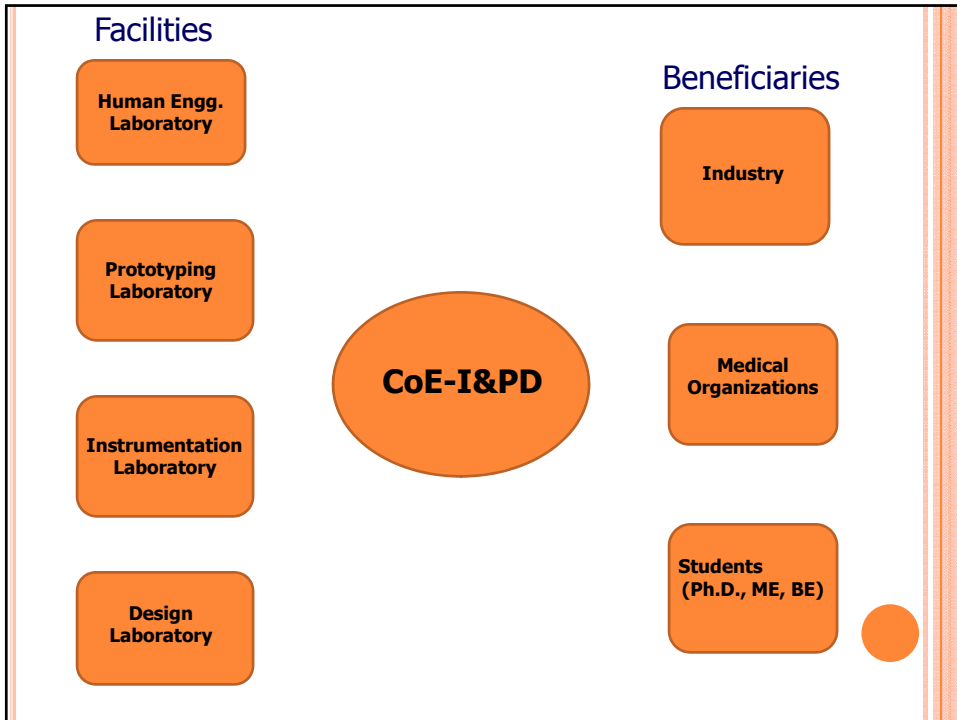
- Ergonomics
- Prototyping and Design Applications in Medical Sciences and Industry



Inception of CoE

- Date of approval of CoE: July, 2013
- Release of grant by NPIU to SPFU: September, 2013
- Release of grant by SPFU to PEC after adding State share: December, 2013





Ongoing / Identified Projects

Ergonomics/form/usability evaluation of industrial systems, hand tools and consumer products:

- Study of Hand Arm Vibration exposure of Indian male workers
- Physiological evaluation of manual handling of low loads at high frequency
- An Ergonomic Evaluation of Ingress and Egress Motion of Users of Chandigarh Transport Undertaking (CTU) Buses.
- Ergonomic evaluation of Ingress and Egress activity of a bus driver

Ongoing / Identified Projects

- Exposure of tractor operators to Whole Body Vibration
- Evaluation of existing consumer products (school bags, handy cams) for functionality, form, usability and ergonomics.



Project:- Study of hand arm vibration exposure of Indian male workers

Research Team:

Faculty: Dr. Parveen Kalra, Production Engg. Deptt.

Collaborating researcher(s):

Prof. Subhash Rakheja,
Research Chair in Vehicular Ergodynamics
Deptt. of Mechanical and Industrial Engg.
Concordia Univ., Canada

Research Scholar: Siddharth Saha



Background

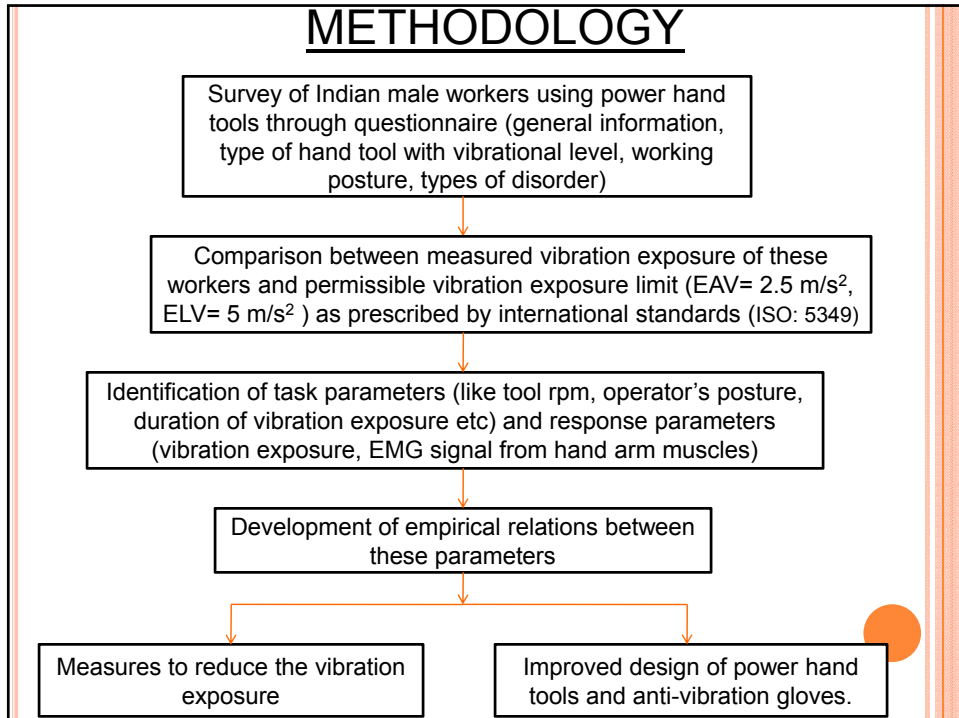
Vascular, neurological and musculoskeletal disorders which manifest as Hand Arm Vibration Syndrome (HAVS) are commonly observed amongst workers, using power hand tools in SME sector in India.

Carpal tunnel syndrome (CTS) which results in pain, numbness and tingling sets in when wrist of hand is exposed to vibration.

The objective of this study is to reduce occupational hazards through appropriate work cycles or job rotation and to improve the design of power hand tools and anti-vibration gloves.



METHODOLOGY



Outcomes

- Monograph(s) would be sent to Regional Labour Institute (a unit of Directorate General, Factory Advice Service & Labour Institutes) Faridabad, CII & MIA for wide circulation.
- Conformance to hand arm vibration exposure standards through establishment of appropriate work cycles or job rotations in SME sector industry.
- Improved design of anti-vibration gloves/power hand tools.

Project:- Physiological evaluation of manual handling of low loads at high frequency

Research Team:

Faculty: Dr. Arun K Lal, Mechanical Engg. Deptt.
Dr. Parveen Kalra, Production Engg. Deptt.

Collaborating Industry: Maruti Suzuki India Ltd, Gurgaon

Research Scholar: Rajesh Kanda



Background

Assembly tasks of high frequency involving light objects are processes where muscle fatigue can be affected by mental fatigue.

One of the techniques used in evaluating such processes is the Occupational Repetitive Action (OCRA) index, which does not take mental fatigue into account.

The objective of this study would be to review guidelines related to handling of low loads at high frequency through independent and simultaneous measurement of EEG and EMG signals.



OCRA Index Value	Risk Level	Consequences
≤ 2.2	No Risk	Acceptable, No consequences
2.3 - 3.5	Very low risk	Improve risk factors or take other organizational measures
> 3.5	Risk	Redesign task and workplace according to priorities



Radiator Assembly at Maruti Suzuki India Ltd., Gurgaon



METHODOLOGY

Survey for identification of mental & muscle fatigue in workers handling low loads at high frequency using questionnaires (BMS, OLBI, NORDIC)

Identification of Control variables (Load, frequency, force, posture, rest/recovery periods)
Uncontrolled variables (Environmental condition like temp, humidity)

Identification of Response parameters (EMG, EEG, EOG, ECG)

Optimisation of response parameters w.r.t. control variables

Review of presently available guidelines from outcome of optimisation

Outcomes

- Existing guidelines for evaluating the risk involved in handling of low loads at high frequency will be reviewed, in the light of the correlation between mental and muscle fatigue, in the Indian context.
- Monograph(s) to be sent to Regional Labour Institute (a unit of Directorate General, Factory Advice Service & Labour Institutes) Faridabad, CII & MIA for wide circulation.



Project:- An Ergonomic Evaluation of Ingress and Egress Motion of Users of Chandigarh Transport Undertaking (CTU) Buses (DST, Chandigarh Project)

Research Team:

Faculty: Dr. Parveen Kalra, Production Engg. Deptt.
Dr. Suman Kant, Production Engg. Deptt.
Dr. Sushant Samir, Mechanical Engg. Deptt.

Collaborating organization: CTU, Chandigarh

Research Scholar: Shailendra Kumar



Background

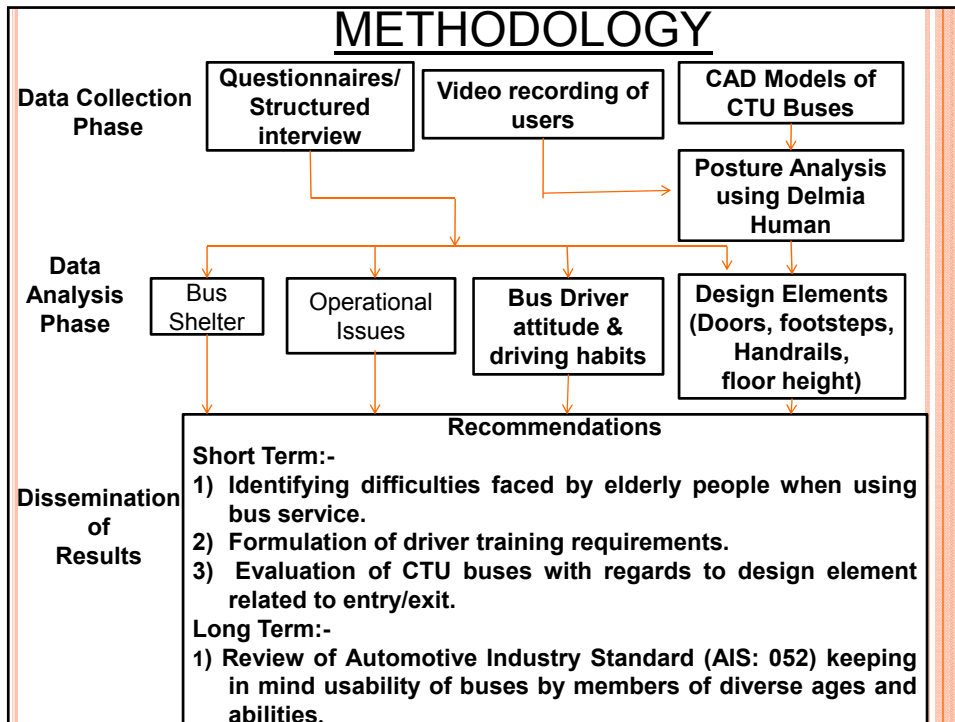
Urban transport should be inclusive enough to cater to all the members of society of diverse ages, abilities and sizes.

Usability of buses is affected by physical features associated with design of bus, bus shelter design, drivers' skill and attitude.

This research project would identify the difficulties people may encounter when they are using public bus service in Chandigarh in particular issues related to ingress and egress. Effects of age and physical impairment on usability of buses would also be studied.

The Body Sections		Good Postures	Awkward postures
The trunk		<30 deg.	30 ~ 90 deg.
The upper arm	Extension	< 60 deg.	> 60 deg.
	Abduction	< 30 deg.	> 30 deg.
The thigh		< 45 deg.	> 45 deg.
The wrist		The fore arm aligned with the hand	The fore arm not aligned with the hand





Project:- Ergonomic evaluation of Ingress/Egress activity of a bus driver

Research Team:

Faculty: Dr. Parveen Kalra, Production Engg. Deptt.
Prof. Jagjit Singh, Production Engg. Deptt.

Collaborating Researcher(s):

Dr. Rauf Iqbal, NITIE, Mumbai
Sh. Sanjeev Kumar, SML Isuzu, Ropar

Research Scholar: Simranjeet Singh

Background

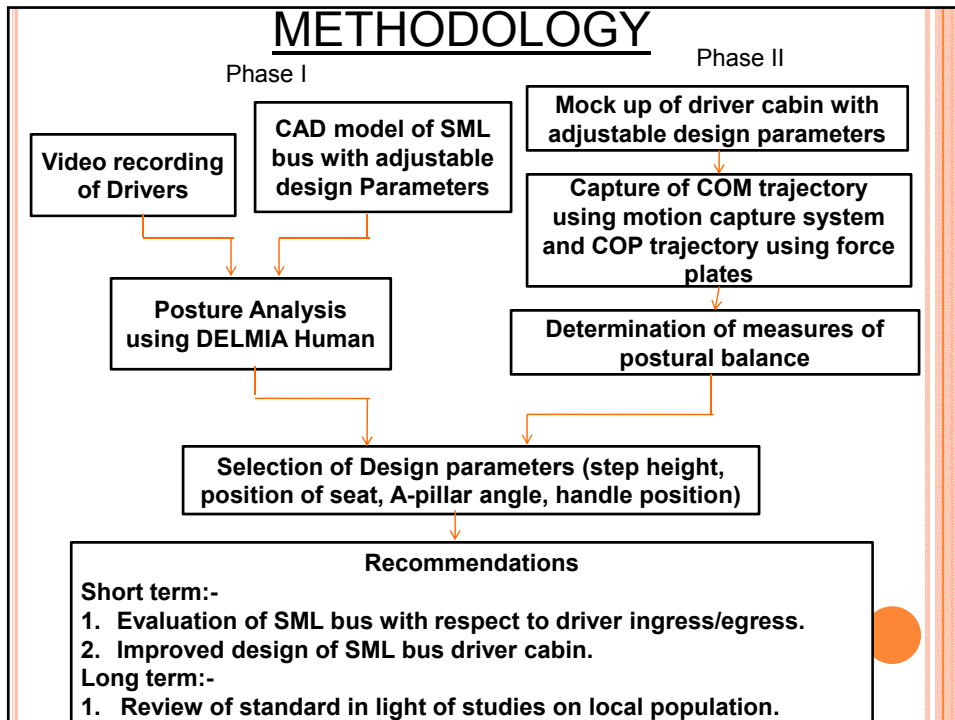
Drivers of bus and other heavy vehicles may be injured when entering and exiting the vehicle.

Computer-aided simulation tools, such as digital human models (DHM), are considered to be very promising in the facilitation of proactive ergonomic assessment.

The objective of this study is carry out a software-based assessment of the egress activity of a bus driver and follow it up by a hardware approach using a motion capture system and force plates.



Driver Cabin Entry/Exit of SML Bus



Project:- On the exposure of tractor operators to Whole Body Vibration

Research Team:

Faculty: Dr. Parveen Kalra, Production Engg. Deptt.
Dr. Suman Kant, Production Engg. Deptt.

Collaborating Researcher(s):

Sh. Jatinder Chawla, Mahindra & Mahindra Ltd.
(Swaraj Tractors Division), Mohali

Research Scholar: Kuljit Singh

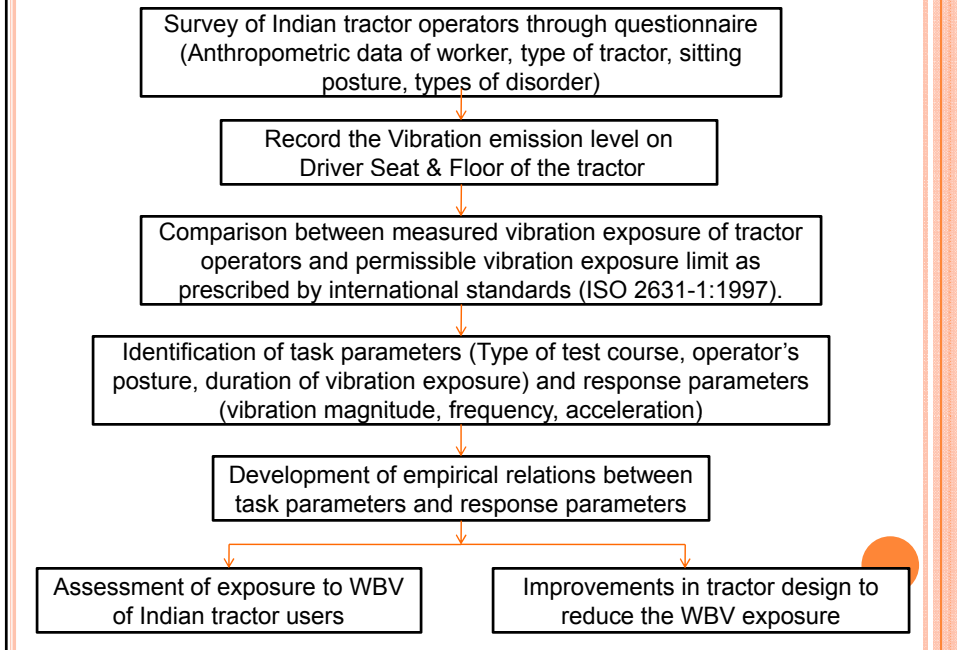
Background

Exposure to high levels of whole-body vibration results in risks to health and safety and can cause or aggravate back injuries and degeneration of intervertebral disc to operators of heavy machinery and tractors.

Risks are greatest when the vibration magnitudes are high, the exposure durations long, frequent, and the vibration includes severe shocks or jolts.



METHODOLOGY



Ongoing / Identified Projects

Prototyping and design applications in medical sciences and industry

- Additive Manufacturing applications in reconstructive surgery
- Development of fixtures and workplace organizational aids through additive manufacturing
- Exploration of non-invasive solutions for physiological parameter monitoring

Project:- Additive Manufacturing applications
in reconstructive surgery

Research Team:

Faculty: Dr. Parveen Kalra, Production Engg. Deptt.
Dr. Sanjeev Kumar, Mechanical Engg. Deptt.

Collaborating Researcher(s):

Sh. Vijay Kumar, CSIO Chandigarh,
Dr. Vijay Goni, PGIMER, Chandigarh

Research Scholar: Varun Arora



Background

There is a growing trend in the medical industry to develop patient specific solutions including means and methods that could provide surgeons the ability to improve their pre-operative planning.

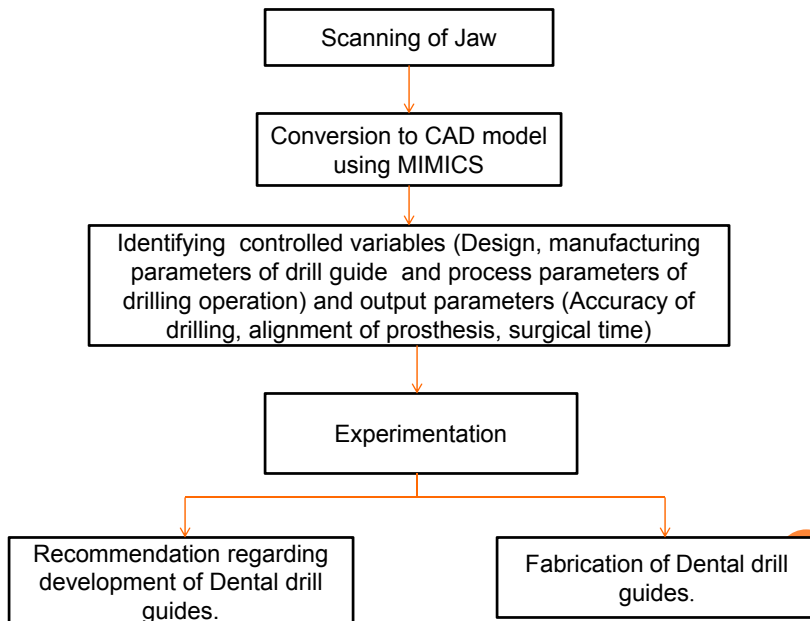
Appropriate solutions in this regard can be provided though Additive Manufacturing.

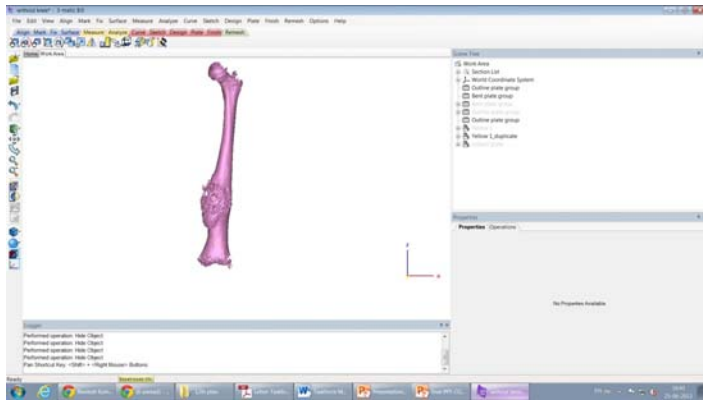
Focus of this study is to provide solutions in the areas of orthopaedic surgery, dental drill guides and maxillofacial surgery.



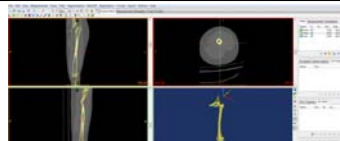


METHODOLOGY





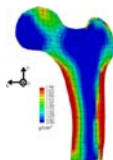
Infant femur bone with tumor
(Data from TATA Memorial Hospital, Bombay)



CT data to 3D model



Muscle forces



FEA Analysis

Integration of MIMICS, AnyBody modeling system,
Hypermesh and ABAQUS software

Outcomes

- Development of 3D models for pre-surgical planning and patient counseling.
- Development of Surgical guides and patient specific implants for PGIMER & other hospitals.
- Development of cost effective trabecular orthopedic implants



Project:- Development of fixtures and workplace organizational aids through Additive Manufacturing (AM)

Research Team:

Faculty: Dr. Parveen Kalra, Production Engg. Deptt.
Dr. C S Jawalkar, Production Engg. Deptt.
Prof. Jagjit Singh, Production Engg. Deptt.

Collaborating Researcher(s):

Sh. Gaurav Bharghav, PCL Mohali

Research Scholar: Ashish Chopra



Background

Replacing conventionally manufactured fixtures with additively manufactured ones will reduce fabrication expenses, labor inputs and fabrication time.

The overall cost-effectiveness in such a situation is undisputable for batch production volumes subject to strength and size constraints.

If tools and materials are conveniently located in uncluttered work areas the operators spend less time looking for items and this leads to higher workstation efficiency - a fundamental goal in mass production.



Organizational aids for keeping tools at a workstation can be easily manufactured using AM.



New thermoplastic Fixture



Original Aluminium
Emblem Assembly Fixture



METHODOLOGY

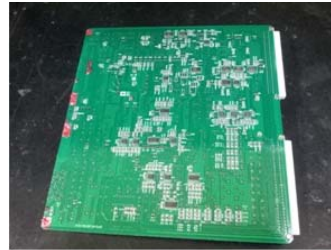
Identification of areas within industry like fixturing, organisational aids where benefits of AM can be extended.



Design and cost analysis of fixtures/organisational aids.



Fabrication of fixtures/organisational aids.



PCB with masking (PCL, Mohali)



Original carrier (PCL, Mohali)

Outcomes

- Cost-effective solutions for fixturing and organizational aids at workplace for increased productivity in SME sector industries around Chandigarh

Project:- Exploration of non-invasive solutions for physiological parameter monitoring

(Communicated to CSIR, Human Resource Development Group, Extramural Research Division II)

Research Team:

Faculty: Dr. Neelam R Prakash, Electronics Engg. Deptt.
Prof. Jasbir Kaur, Electronics Engg. Deptt.

Collaborating Researcher(s):

Dr. Amod Kumar, CSIO Chandigarh,
Sh. Amit Laddi, CSIO Chandigarh,
Smt. Shashi Sharma, CSIO Chandigarh,
Dr. Ajay Behl, PGIMER, Chandigarh,
Sh. Jaspal Singh, CDAC, Mohali

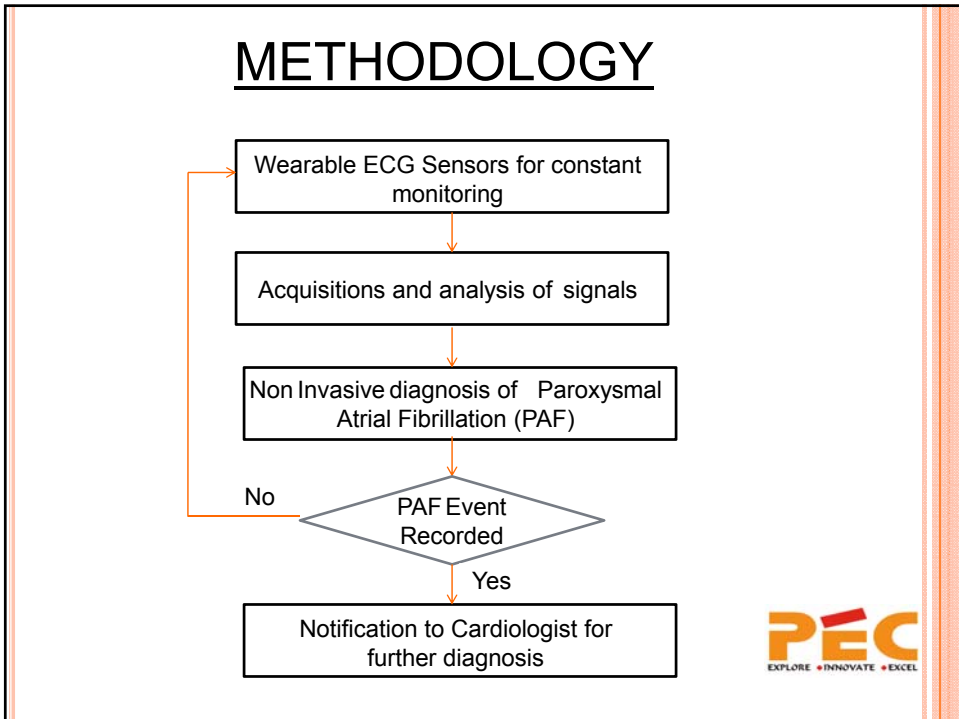
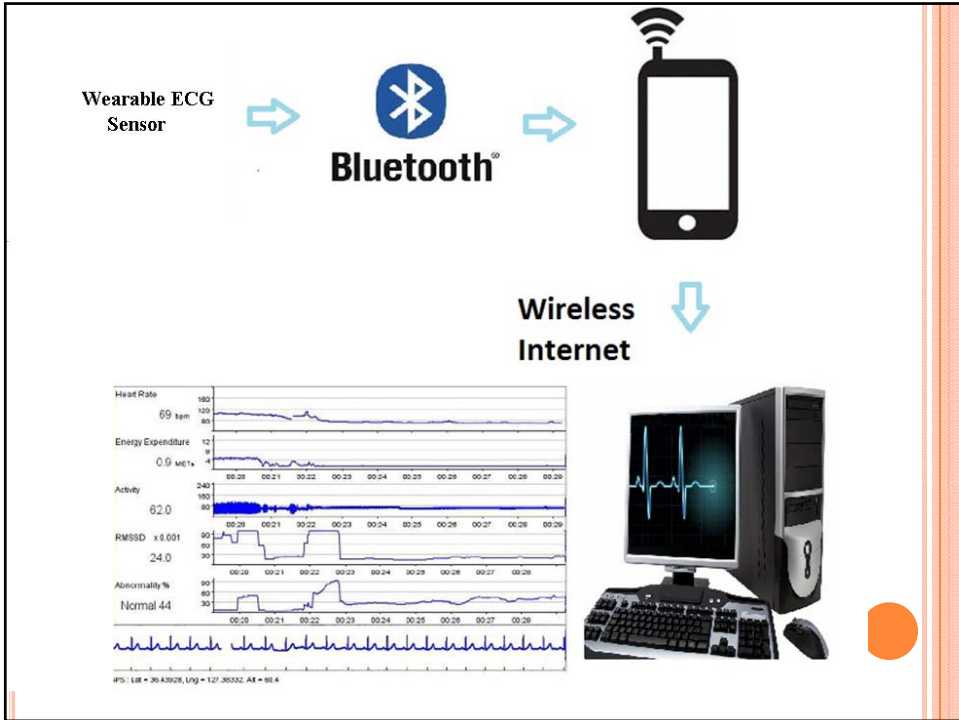
Background

India is yet to explore the benefits of non-invasive diagnosis of diseases using bio-sensors. Little information regarding similar work in this direction is reported in India so far.

Techniques in the direction of non-invasive diagnosis of certain diseases which can become serious if not detected in a timely manner need to be explored.

Most paroxysmal atrial fibrillation (PAF) terminate spontaneously with in 24 hours but share similar stroke risks with long lasting persistent AF.

The focus of this research would be on detecting and monitoring of paroxysmal atrial fibrillation (PAF) using non-invasive methods.



Outcomes

- Prolonged ECG monitoring by event recorders would improve detection rate of PAF cases in contrast to earlier Holter monitors (for 24 to 48 hours) where detection of PAF is low (~ 20%).

Facilities being created

Human Engineering Laboratory

- Portable EMG system
- EEG-EMG system
- Whole body and Hand arm vibrations analysis kit, Electronic dynamometer, Electronic pinchmeter
- Pressure mapping system (seat and back)
- Delmia Human software
- Anthropometric kit
- Oxygen analyser

Facilities being created

Prototyping Laboratory

Equipment under procurement:

- 3D scanning system
- FDM Rapid Prototyping machine
- Polyjet Prototyping machine



Facilities being created

Design Laboratory

Equipment under procurement:

- MIMICS software
- 3Matics FEA Analysis software
- Magics RP software
- Digital Canvas



Facilities being created

Instrumentation Laboratory

- NI Simulator
- NI DAQ cards
- Sensors (Humidity, temperature, PH)
- Data logger cards
- LabVIEW
- ORCAD software

Equipment under procurement:

- Bio-sensors



- Progress Review of CoE
- Action Plan (April 2014 – Dec. 2014)
- Financial Report (30 April, 2014)



Thank You

