IIT Bombay

R & D at IIT Bombay

Dean (R&D)
IIT Bombay
Powai, Mumbai 400076
+91-22-2576 7039
dean.rnd.office@iitb.ac.in
www.ircc.iitb.ac.in

IIT Bombay at a Glance

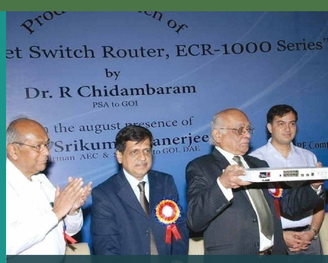
- Academic units: 27; Research centres: 21
- Faculty: ~620
- Students: ~10,000 (2941 PhD)
- Postdoctoral fellows: ~130
- Degrees awarded in 2016: 2515
- R&D funding for (April-Dec 2016): ₹285 Cr.
- Publications in 2016: 1785
  (Journals: 1274; Conference: 511)
- Indian patents filed (2016): 81
- Technology transfers/deployment so far: ~150
- Total companies incubated: 99

Industrial Research and Consultancy Centre (IRCC)
Nodal unit for coordinating and managing activities related to R&D

Patents

Period 1.1.1997 to 1.1.2017

- Indian patent applications: 659
- Foreign patent applications: 123
- PCT applications: 102
- Patents granted (Indian + Foreign): 124 + 54
  - Others under process

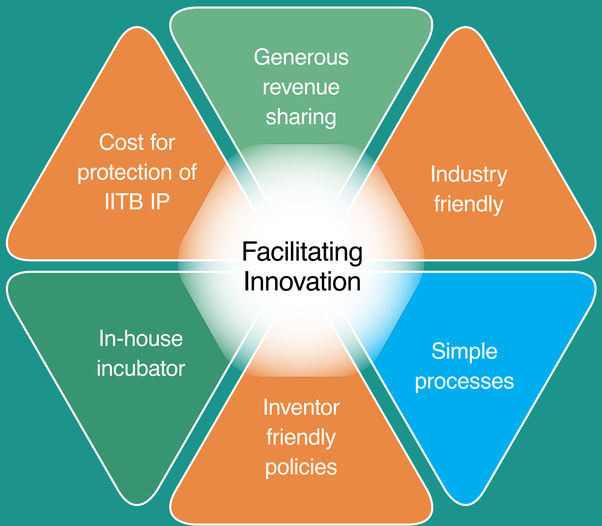


Indigenously developed ECR-1000 ethernet switch router

Soil Biotechnology based sewage treatment plant at Mumbai Corporation

IITB wins the National Intellectual Property Award 2015

Fuel additives



Roadmap to rural connectivity

IIT Bombay

Energy Conservation Systems

Tube tube heat exchanger
- Low cost double vented wall heat exchanger
- Compact and cost effective

Multi-utility heat pump
- Integrated, low cost compact, easy to operate
- On-demand supply of hot / cold water

Diabetic contacting device
- Air humidifier
- Indirect evaporative cooler
- Evaporative condenser/de-superheater/sub-cooler
- Fresh air dehumidifier
- Hybrid air conditioning system

Multi-utility heat pump

Diabatic contacting device

☑ Heating / cooling - Air / water / process fluid

Status:
Available for licensing

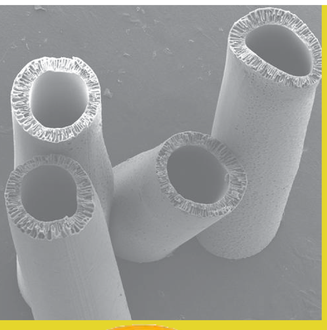
Exhaust heat recovery unit

Tube tube heat exchanger

Prof. M. V. Rane
Dept. of Mechanical Engineering
ranemv@me.iitb.ac.in

IIT Bombay

Hollow Fibre Membrane Technology for Kidney Dialysis



- Imported lifesaving haemodialysers are very expensive and unaffordable
- Economically viable Hollow Fibre Membrane (HFM) technology for haemodialysers developed
- Greater biocompatibility and superior separation performance

Features & Advantages
- High performance compared to commercial haemodialysers
- Superior bio-compatibility for renal patients
- Low cost indigenous technology
- Shorter dialysis time

Users
- Manufacturers of haemodialysers
- Patients, nephrologists, industry, dialysis centres and hospitals

Status:
Preparation of hollow fibre cartridges, Animal and clinical trials under initiation; patent pending

Preparation of Hollow Fiber Cartridges, Conducting Animal and Human Trials

Prof. J. Bellare
Dept. of Chemical Engineering
jb@iitb.ac.in

IIT Bombay

Low Cost Soil Monitoring System For Irrigation Control

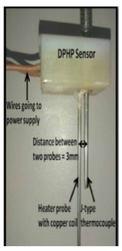
Field deployment: Hyderabad

Field deployment: Nasik

- Soil moisture / temperature sensor, ambient humidity / temperature sensor,
- Sensors and systems for agricultural and civil engineering applications
- Effective use of water in agriculture, sustainability
- Make it profitable to farmers

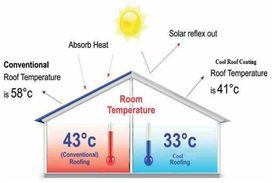
Field deployment: Delhi

Prof. M. S. Baghini
Dept. of Electrical Engineering
maryam@ee.iitb.ac.in



Acknowledgments: Meity, IISc, Semi-Conductor Laboratory, Dept. of Space, Govt. of India

Status:
Patents pending, 'SoilSenS' under process of incubation



IIT Bombay

Dark Colored Cool Roof Coatings Technology

- Designed to reflect Near Infra Red (NIR) waves of solar radiation, on roof
- Lowers roof / room temperature by 10-14^{0}C
- More effective than conventional insulation coating
- Available in wide range of colors
- Highly affordable
- Excellent surface finish
- Good waterproofing / weatherability
- Easy application

☑

- Agricultural and industrial buildings
- Temporary / permanent roofing materials
- Tiles, shingles, marble slabs, concrete walls etc.

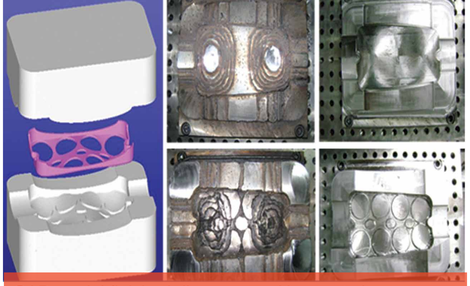
Status:
Available for licensing

Prof.A.S.Khanna
Dept. of Metallurgical Engineering and Materials Science
khanna@iitb.ac.in

IIT Bombay

Rapid Tooling and Manufacturing of Metallic Components

Hermle 5-axis CNC machining centre



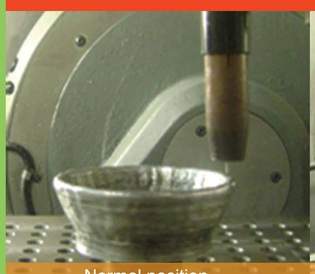
CAD model finished dies Near-net shape

- Uses combined additive and subtractive Hybrid Layered Manufacturing (HLM) process
- Near-net shape manufactured in layers by depositing metal through MIG welding
- Faster and cheaper than laser and electron beam based deposition systems
- Can be adopted as a retro-fitment to existing CNCs
- Complex features possible

☑

- Planar deposition in 3-axis HLM for small undercuts and after blinding them
- Non-planar and variable axis deposition
- Multiple welding torches based deposition

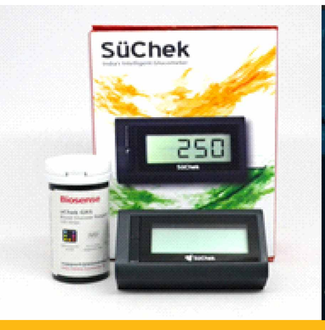
Prof. K. P. Karunakaran
Dept. of Mechanical Engineering
karuna@me.iitb.ac.in



Normal position (Greater overhang)

Tilted position (Overhang in-line with)

Case study



IIT Bombay

SüChek & uChek: Diagnostic Devices

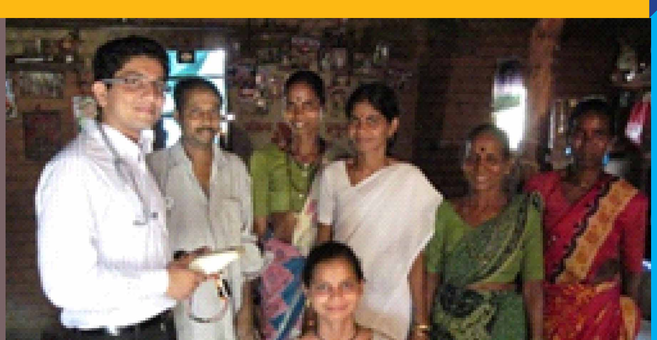
SüChek
A cost-effective glucometer

- High accuracy: compliant with ISO 15197
- Uses low cost colour changing reagent strips
- Mobile connectivity: effective analysis
- Small, portable and lightweight (<100 gms)

uChek
A mobile based low-cost, efficient and error proof urine analysis system

- ≥ 95% accuracy; registered with USFDA
- Affordable, simple to use, results in <5 seconds
- < 500 gms; bedside testing possible
- Integrated data organiser

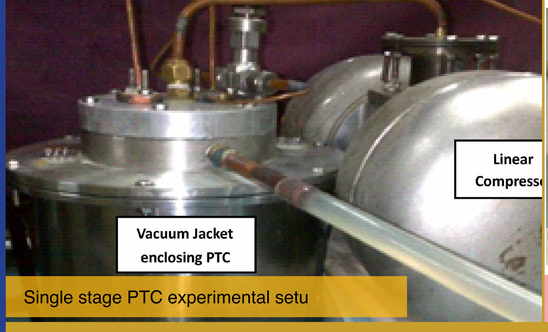
Status:
Produced and marketed by Biosense Technologies Pvt Ltd.



Prof. R. Srivastava
Dept. of Biosciences & Bioengineering
rsrivasta@iitb.ac.in

IIT Bombay

Cryocoolers



Single stage PTC experimental setu

IInline; U-type: coaxial single-stage PTCs

Pulse Tube Cryocoolers

- Vibration and maintenance free
- Can attain & maintain temp. < 80K
- Single Stage PTC–U-type: 50-60K in 30-40 mins
- Two-Stage PTC–U-type: 20-25K attainable in 1 hr

☑

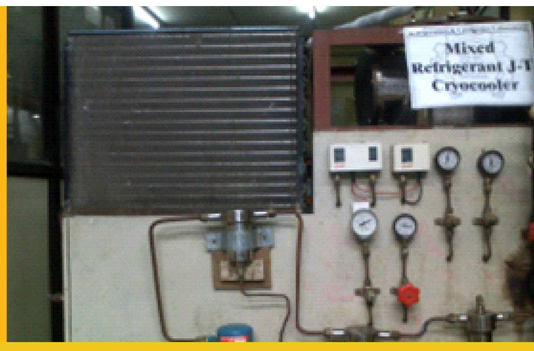
- Imaging equipment for night vision and heat-seeking missile guidance
- Cooling electronic devices and sensors

Status:

- Customisation possible
- Ready for commercialisation

Mixed Refrigerant Joule-Thomson Cryocooler

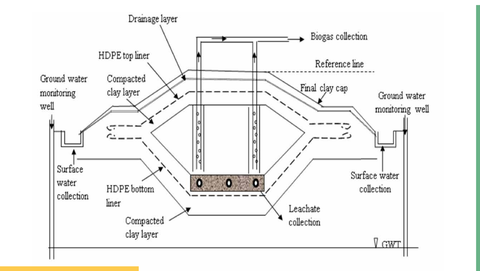
- low cost, efficient, reliable
- 70–120K in <1 hour



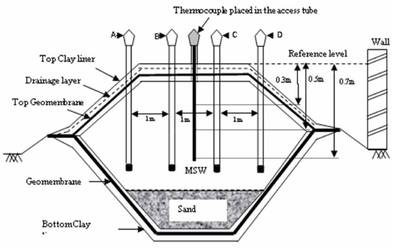
Prof. M. Atrey
Dept. of Mechanical Engineering
matrey@iitb.ac.in

☑

- Cooling of infrared sensors
- Gas cooling / liquefaction
- Cryo-preservation
- Laboratory equipment



SEBLF-AN



installation of the FDR probe and thermocouple in the SEBLF-AN

IIT Bombay

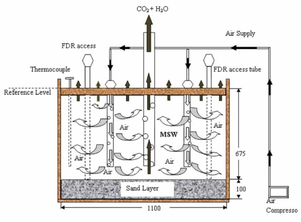
Sustainable Landfills for Small Townships

- Economical method for disposing municipal solid waste (MSW)
- Decentralized sustainable engineered bioreactor landfills (SEBLF) developed
- Accelerates decomposition / energy recovery and value added products
- Aerobic and anaerobic field models developed
- Moisture content and temperature of MSW monitored / controlled
- Recirculation of leachate to accelerate decomposition
- Periodic analysis of recirculated leachate characteristics
- Good reduction in C, H and N content in the bioreactors

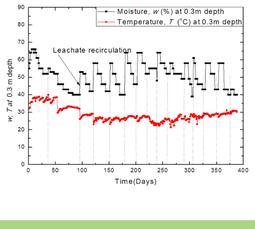
Prof.D.N.Singh
Dept. of Civil Engineering
dns@civil.iitb.ac.in

☑

- Accelerated decomposition
- Energy recovery and value added products



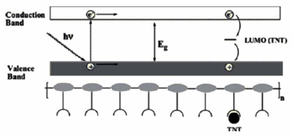
SEBLF-AE



Typical variation in the moisture and temperature with time in the SEBLF

IIT Bombay

Beagle-Z: Handheld Explosive Detector



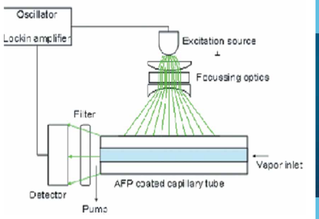
Beagle-Z: to empower homeland security

- Amplifying Fluorescent Polymer based handheld device
- Proprietary embedded software running on microcontroller
- RS-232 Serial Interface based communication
- 7.5V, 2200mAh (Li-ion battery pack), 12V DC adaptor
- Real-time detection
- No radioactive source

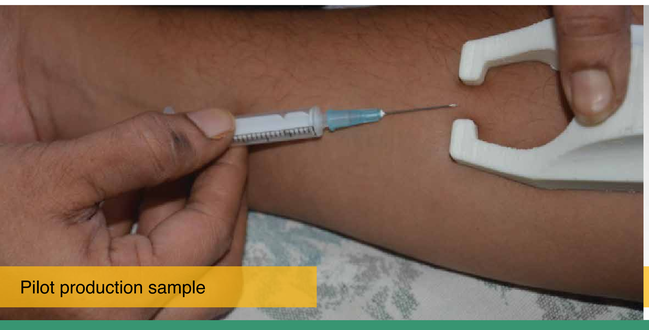
☑

- People Screening: Check points, Post blast sites
- Vehicle Screening
- Building screening: terrorists hot-spots, places of importance, crowded establishments

Prof.Anil Kumar
Dept. of Chemistry
anilkumar@iitb.ac.in



Status
Technology transferred to Bigtec Pvt. Ltd.


Pilot production sample

Final prototype rendering

IIT Bombay

Low Cost Vein Tracer

- Convenient, light weight and affordable
- Ergonomic, user friendly
- LED light deflected by deoxygenated blood giving a clear silhouette of veins

☑

- In busy and frugally run blood camps
- Blood banks
- Small and medium sized hospitals

Prof. B. K. Chakravarthy
Industrial Design Centre
chakku@iitb.ac.in

Status:
Usability testing underway

Study of form for gripping and ease of use

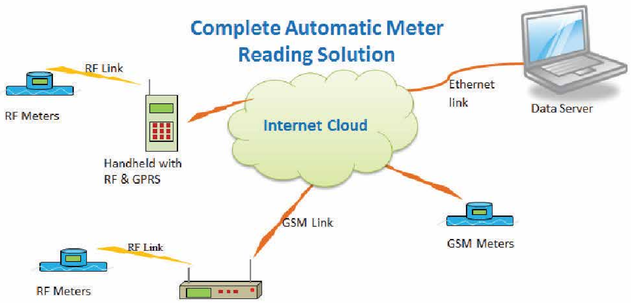
IIT Bombay

Smart Ultrasonic Water Meter

- Low cost, accurate and reliable domestic water meter
- For both rural and urban water supply schemes
- Low maintenance
- No moving parts
- Long battery life >5yrs
- Alarms: misuse-tamper; reverse flow
- Tailor made billing software
- Highly accurate & reliable
- Automatic wireless data collection on centralized server

☑

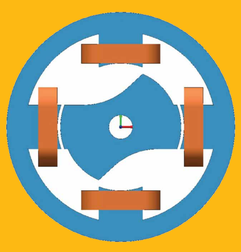
- For individual houses, high rise residential complexes, and commercial complexes



Status

- Field tested on IIT Bombay campus
- Ready and available for licensing

Prof. P. S. V. Nataraj
Systems and Control Engineering
nataraj@sc.iitb.ac.in



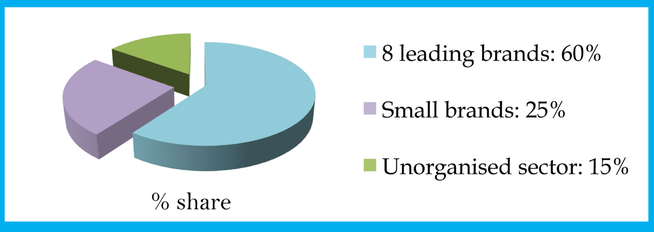
IIT Bombay

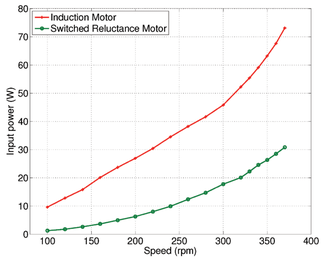
Novel Switched Reluctance Motor Drive for Ceiling Fan

- Singly excited motor
- No permanent magnets
- No coils on rotor
- High reliability
- Lower PE requirement
- DC grid compatibility
- Smart control

- Current market share of high efficiency fans: 0.2%
- 350 million existing Induction motor fans

The market: 40 million/year





- High efficiency
- Low cost
- High payback
- Up to 50% less power consumption
- Potential savings:
  - 19,162 GWhr/yr
  - 8,750 MW peak

Prof. B. G. Fernandes
Dept. of Electrical Engineering
bgf@ee.iitb.ac.in

Diabetic Foot Screening Device

IIT Bombay

- Handy and compact design
- Sensitive sensor to measure force accurately
- Reduces cost burden
- 5 wire connection
- 5 Volts DC, 100Hz
- Operating force: 0-1.5lb
- Operating temperature: 0 to 70^{0}C

Status:
- Primary trials being conducted
- Prototype to product underway

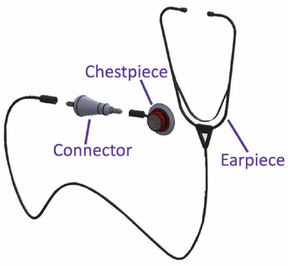
Prof.B.Ravi
Department of Mechanical Engineering
bravi@me.iitb.ac.in
chetan.pakhare@betic.org
www.betic.org

DigiSteth - Digital stethoscope

IIT Bombay

- Transforming any stethoscope into a "Digital Stethoscope"
- Volume control
- Recording and playback option
- Bluetooth connectivity
- Detachable chest-piece
- Provision for simultaneous auscultation

Status:
- Patent filed
- Available for licensing



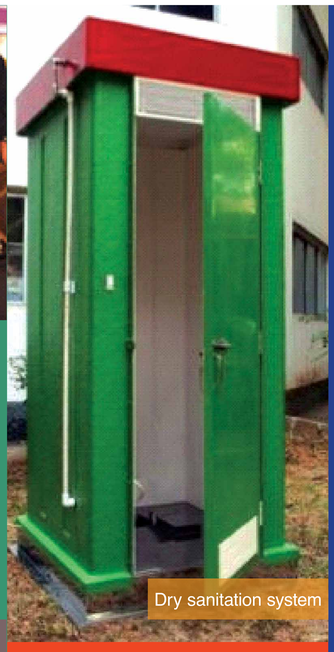
Prof. B. Ravi
Dept. of Mechanical Engineering
bravi@me.iitb.ac.in
www.betic.org

Product Designs

IIT Bombay

Board Games
- Short games for entertainment
- Encourage spatial intelligence and mental imagery
- Allows foresight and planning capabilities

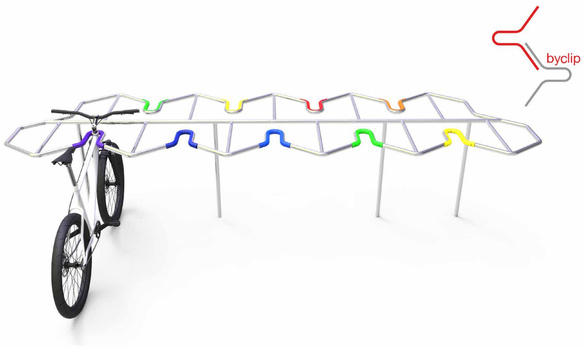
Status:
Design registrations filed; Manufactured and marketed by the Funskool (India) Ltd.; `Zero Sum' in Japanese market by Gakken



Dry sanitation system

▲
- Patent filed
- Licensed to C Tech Pvt. Ltd.

ByClip:Bicycle parking rack



◀
User centric novel design for effective arrangement of large no. of bicycles

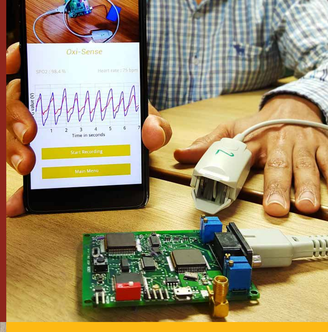
Industrial Design Centre
www.idc.iitb.ac.in

IIT Bombay

Technologies for Wearable Health Monitoring

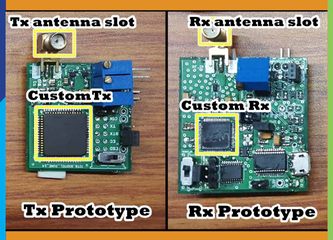
Technologies to monitor ECG, EMG, EOG and SpO_2, for implantable and wearable applications

Compact prototypes with customised Application Specific Integrated Circuits (ASICs)

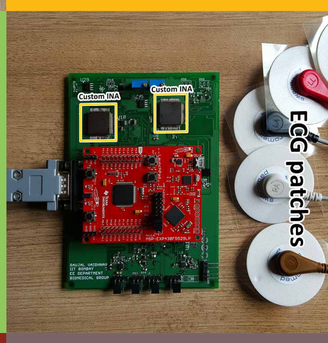


Oxi-Sense: Non-invasive, fast, accurate measurement of blood oxygen saturation level and heart rate using custom designed ASIC

Life-Sense : Real-time monitoring of ECG/PPG data on any Android mobile or desktop



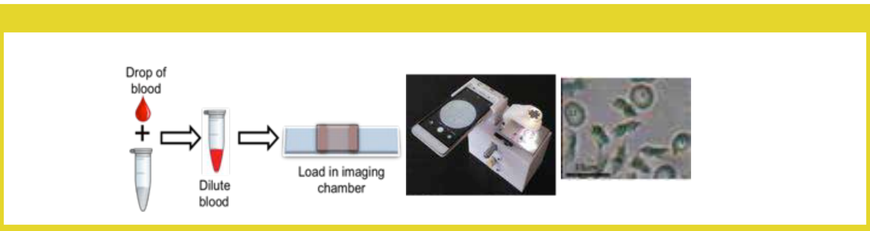
Heart-Sense: Light weight portable device for continuous monitoring of ECG and heart rate



Bio-WiTel: Custom set of transmitter and receiver ASICs

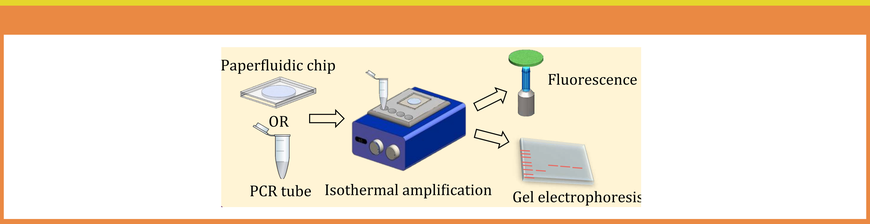
Status: Patents pending; prototypes successfully tested in home and hospital environment

Prof. Maryam S Baghini
Dept. of Electrical Engineering
maryam@ee.iitb.ac.in



Mobile microscopy platform to detect sickle cell disease

- Early stage dignosis for faster management
- Easy, quick and affordable



Paperfluidic platform for rapid amplification of tuberculosis DNA

- One-step disinfection, lysis and amplification technique
- Less manual intervention

Home-based monitoring of oral health

- Fully printable paper-fluidic device
- Cheap, disposable, easy to manufacture
- Suitable for oral health monitoring and screening

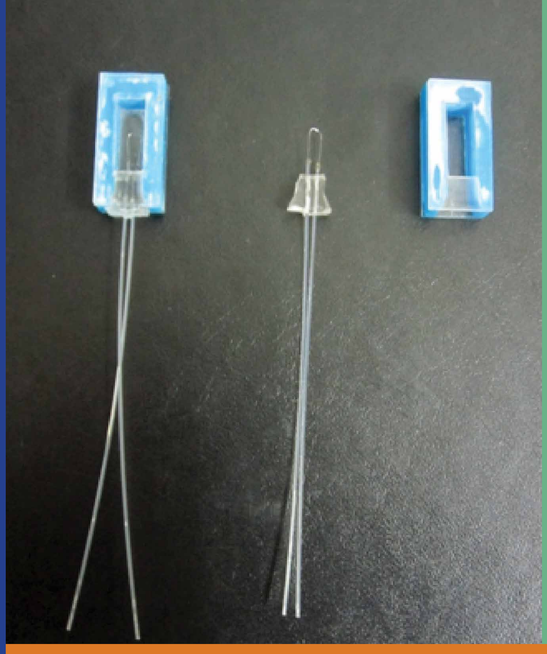
IIT Bombay

Technolgies for Affordable Healthcare

Prof. Debjani Paul
Dept. of Biosciences and Bioengineering
debjani.paul@iitb.ac.in

IIT Bombay

μSENS - Fiber Optic Based Detection System



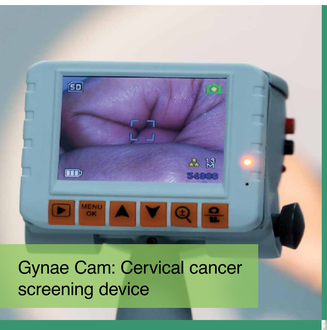
- UV light emitting diode, spectrometer
- U-bent fiber optic probe of 200μm core diameter, 0.75mm bend radius
- Effective probe length of 1cm

- Low cost portable system for detecting *E. coli* bacteria
- Based on evanescent wave absorbance
- Able to perform real time, label-free detection of ~250 *E. coli* cells in 0.25 ml sample
- Modest detection limit obtained as trade-off between sensitivity and simplified design

Instrumentation:

- UV source: T9H28C (280nm)
- UV detector: SIC01M (280 – 400nm)
- Multimode optical fiber, core diameter of 200 – 400μm
- Microcontroller: MSP430F1611
- Display unit: 20 × 4 line Alphanumeric LCD display

Prof. Soumyo Mukherji
Dept. of Biosciences and Bioengineering
mukherji@iitb.ac.in



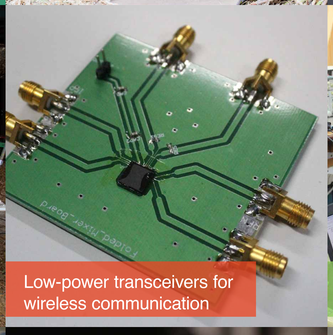
Gynae Cam: Cervical cancer screening device

The centre aims to develop solutions to challenges faced by resource constrained communities using an end to end innovation approach

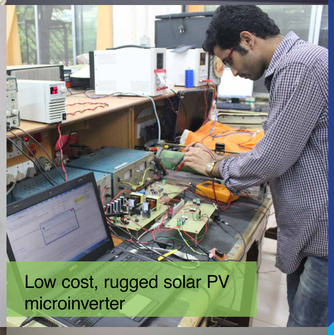
Removing drudgery in jaggery-making

Clay-based water purifier

Gasifier based cook-stoves for garden waste

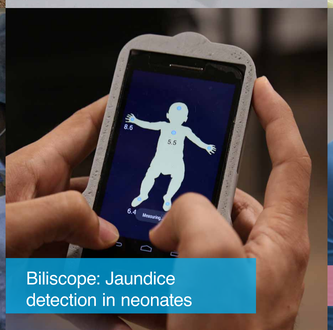


Low-power transceivers for wireless communication



Low cost, rugged solar PV microinverter

Functional nanohybrids to treat cancer



Biliscope: Jaundice detection in neonates

Bone graft for bone reconstruction

IIT Bombay

Tata Centre for Technology and Design

Tata Centre for Technology and Design
office.tctd@iitb.ac.in