Smart Flushing: A Health Monitoring System

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- **Problem Statement**
  - Certain studies are indicative of the fact that one in four kids has either pre-diabetes or diabetes. Nearly 1 million Indians die due to diabetes every year. Over 30 million have now been diagnosed with diabetes in India.
  - The CPR (Crude Prevalence Rate) in the urban areas of India is thought to be 9%. In rural areas, the prevalence is approximately 3% of the total population.
  - About 40% of women and 12% of men experience at least one symptomatic UTI (Urinary Tract Infection) during their lifetime. The prevalence of UTI in pregnant women in India is reported to range from 3% to 24%.

The situation can be tackled with proper medication and early detection. Therefore, the project aims to develop a device that will help in early detection of various problems.

- **How did I get the idea?**
  - I got this idea from my own class. One of my classmates is diabetic. She takes various medications during the lunch time. She told me that she got to know about the disease in Class 2. She even told me that many people, mainly poor, die due to diabetes every year. Therefore, I thought of taking up a project based on setting up such toilets in slum and rural areas.
  - To start with, in the school exhibition, I took up the same topic and had built a prototype with the help of my science teachers and the ATL (Atal Tinkering Lab) department. In the exhibition, I did a test with the help of reagent strips as the sensor was not available. I took the urine sample of one of my teacher's (age 52) and tested it. It showed a negative result which confirmed that she was not suffering with any of the diseases. If adequate support is provided, I will be able to design a sensor for installation.
- **Background**
  - Human waste contains lots of clues about their health. Many ailments leave their mark in urine and feces, including diabetes, infections, kidney disease and cancer.
  - Indicative of various pathological and normal physiological processes in humans:
    - For example, a detection of ketones in human urine is indicative of diabetes.
    - Detection of increased levels of estradiol in urine of a female human may be indicative of an incoming ovulation.
    - Detection of a combination of fourteen specific molecules is indicative of a prostate cancer in a male human.

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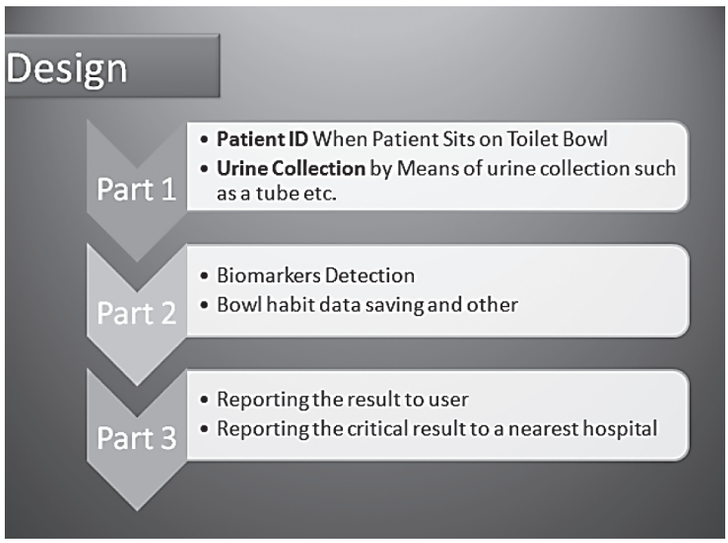
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- Since urine is an important source of information that represents the health conditions of an individual, various dysfunction such as pancreatic disorders (typically, diabetes), hypohepatia, and kidney disorders can be detected advantageously in a non-invasive manner by performing quantitative analysis of certain urine constituents, such as glucose, protein, urobilinogen, occult blood and other substances.

- **What if a 'medical toilet bowl' that could perform…?**
  - Detection of pathological and normal physiological processes in humans on a daily basis and that too automatically via urine analysis.
  - Human waste analysis
  - Microbiome analysis
  - Biomarkers detection
  - Bowel frequency
  - Traces of blood in stool/urine

- **Biomedical System Design & Development**

  Integral Parts of the System
  - Urine collection structure design to be fitted into the toilet bowl.
  - Sensor to sense the biomolecule/marker, e.g. Ketones, Estradiol to be fixed into the smart toilet system.
  - Communication Module (To communicate through servers to various health facility, user mobile among others)
  - A data storing unit.



- **Challenges**
  - Optimization of system for reliability of data generated.
  - Toilet user identification (biometric based solution may be employed)
  - Making it simple & easy to use and affordable

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- **Possible Outcome? Limitless**
  - Doctors ask patients questions about their bowel movements and other details (consistency, color, blood, and so on) where a patient may forget when ill and may be reluctant to give the correct information.
  - A boon for the elderly patients with dementia and other conditions.
  - Day-to-day health monitoring
  - Measuring hormone fluctuation with menstrual cycles for family planning

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