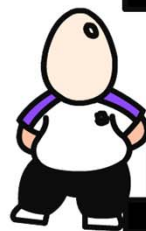


'Smart City Project Programme 18-19' Briefing Session  
2017/18 Winning Teams' Experience sharing

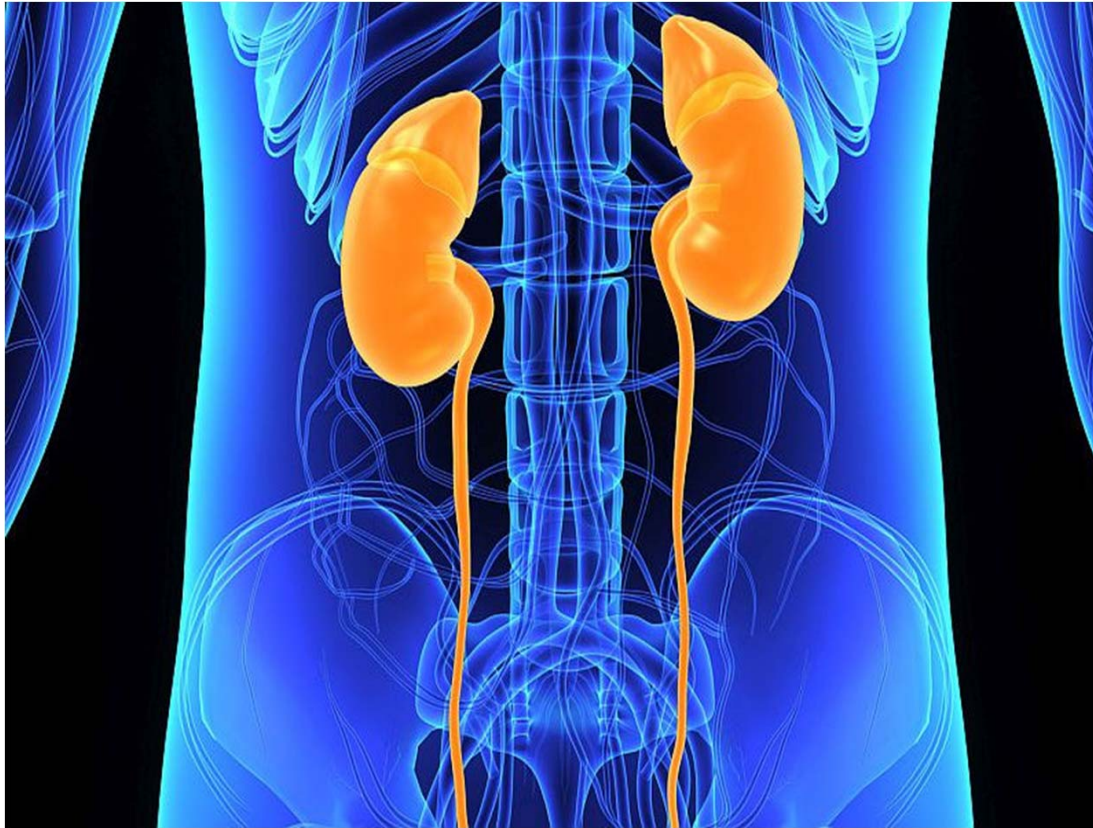
 **KIDNEY**

MA Chiu Chi, Don  
IP Wing Hong, Ben

MARK Chun Hei, Mark  
LEE Chun Lam, Lam



# Problem - Elderly with kidney disease



Problem -Late detection leads to dialysis



# Purpose

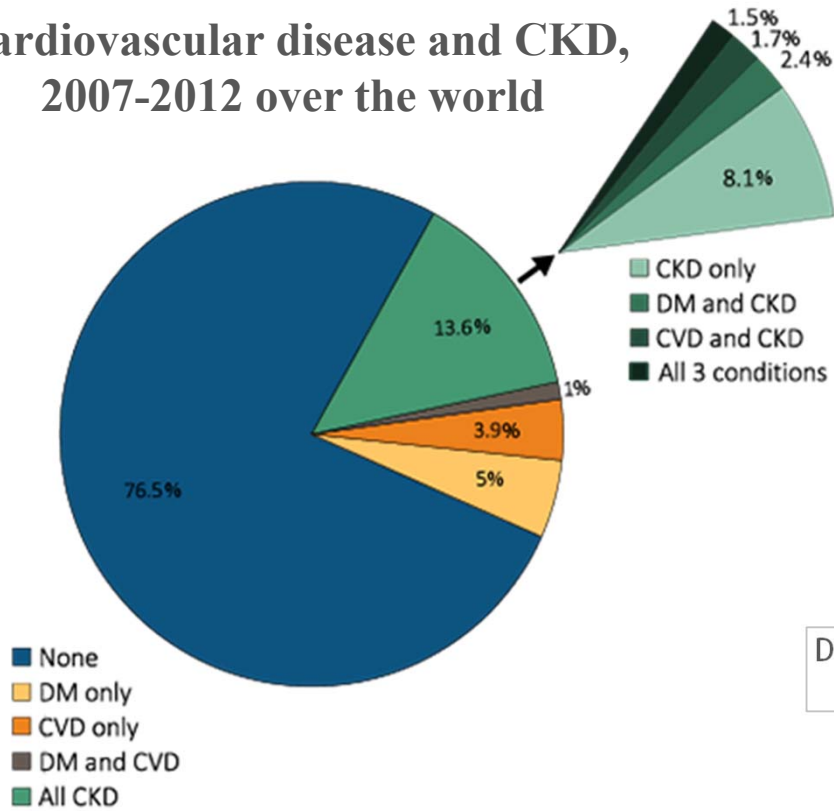
- Help high-risk elderly to assess the condition of the kidney before symptoms and reduce deaths by kidney disease.

# Our solution



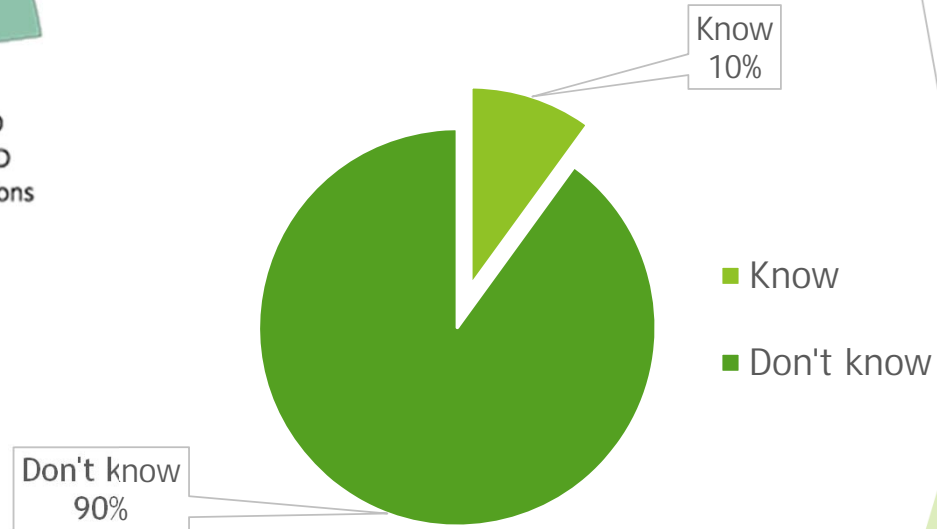
# Background

## Cardiovascular disease and CKD, 2007-2012 over the world



Abbreviations: CKD, chronic kidney disease; CVD, cardiovascular disease; DM, diabetes mellitus

## Discover of kidney disease in early stages



[1] World Kidney Day: Chronic Kidney Disease. 2015; <http://www.worldkidneyday.org/faqs/chronic-kidney-disease>

[2] Levey AS, Atkins R, Coresh J, et al. Chronic kidney disease as a global public health problem: approaches and initiatives - a position statement from Kidney Disease Improving Global Outcomes. *Kidney Int.* Aug 2007;72(3):247-259.

# Diagnosis Indications

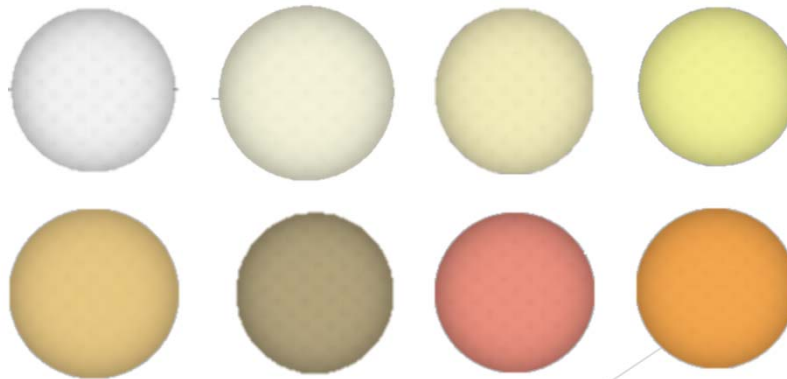
➤ Urinary output

Normal range  
0.8L - 2L

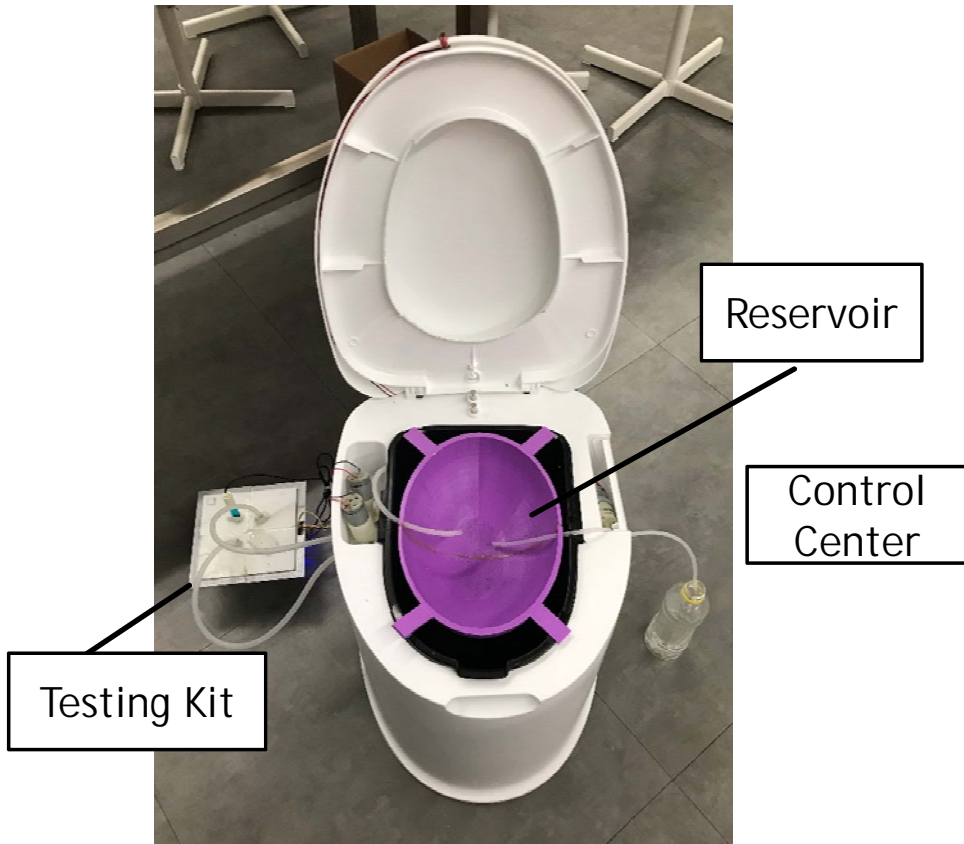
➤ pH

Normal range  
5.5 - 7

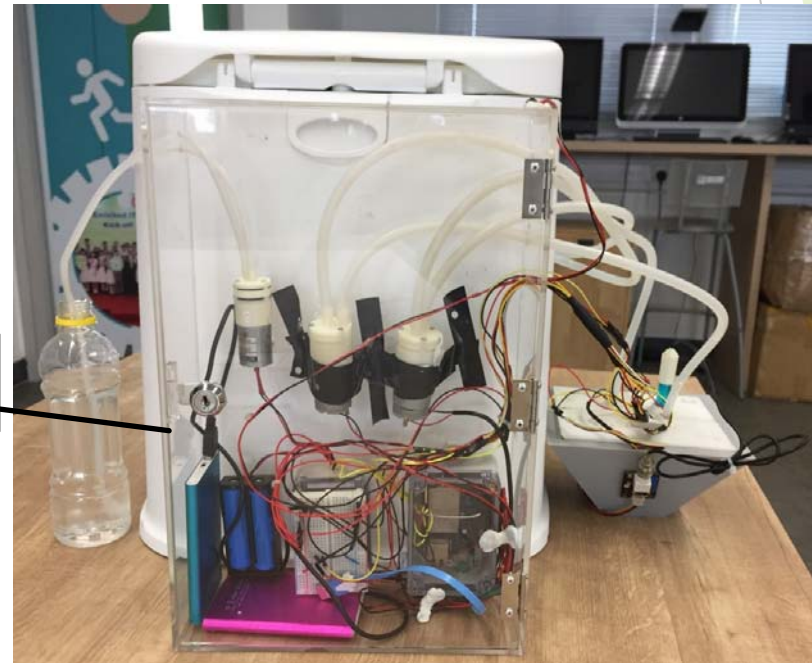
➤ Color



## Overview of the toilet set up



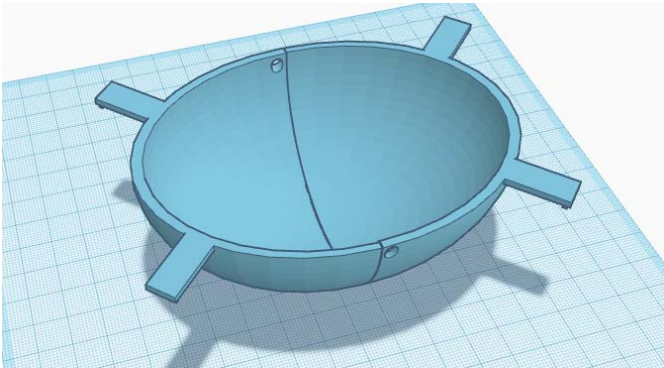
Top view



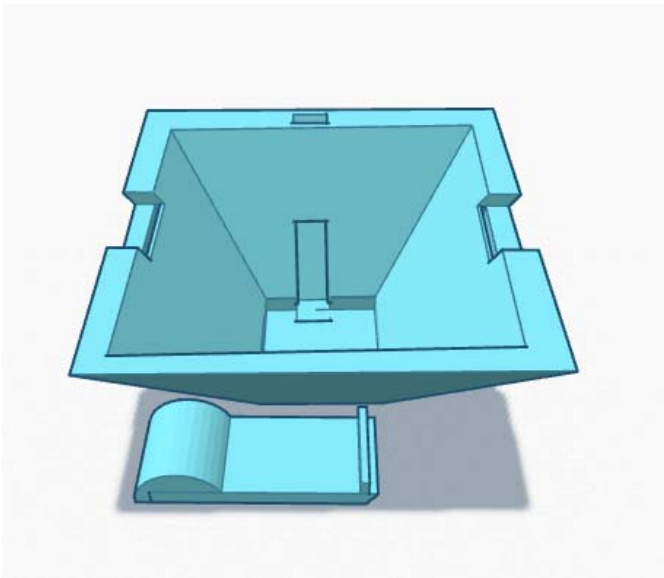
Back view



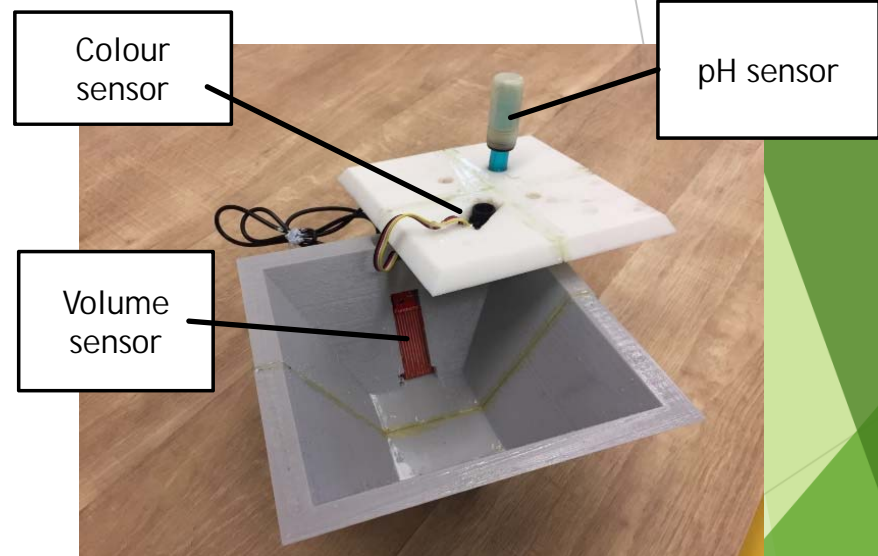
# 3D-Printing Model



Reservoir

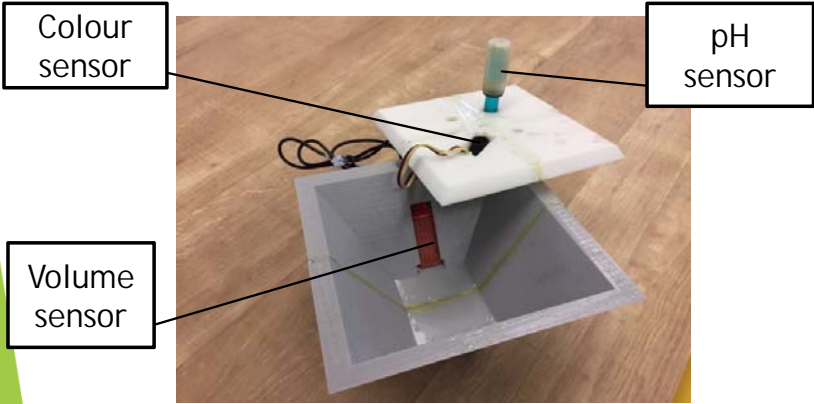
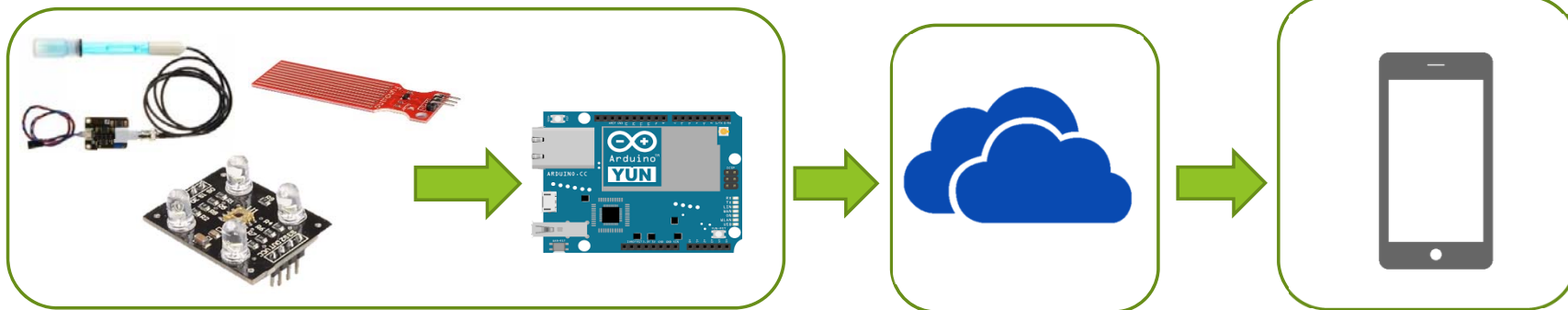


Testing Kit

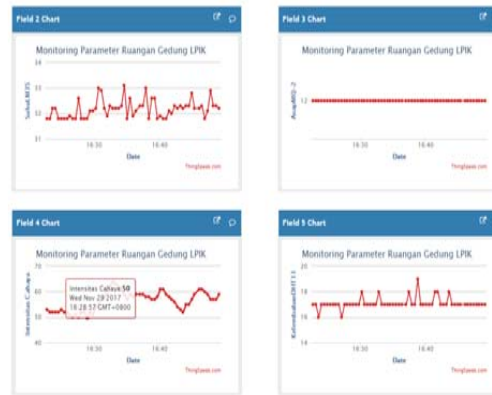


Urine testing Kit

# Configuration



Urine testing Kit



IoT Platform - ThingSpeak

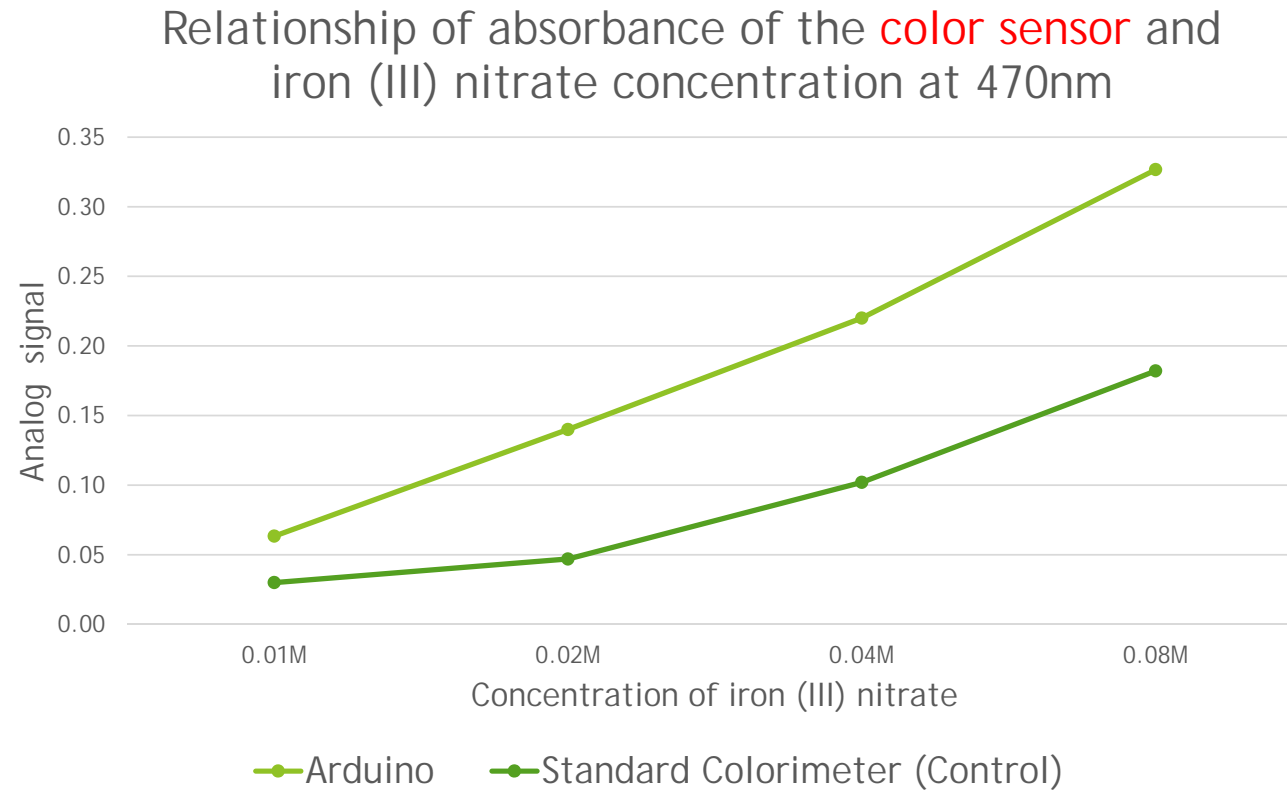


Mobile App

# Display of Results

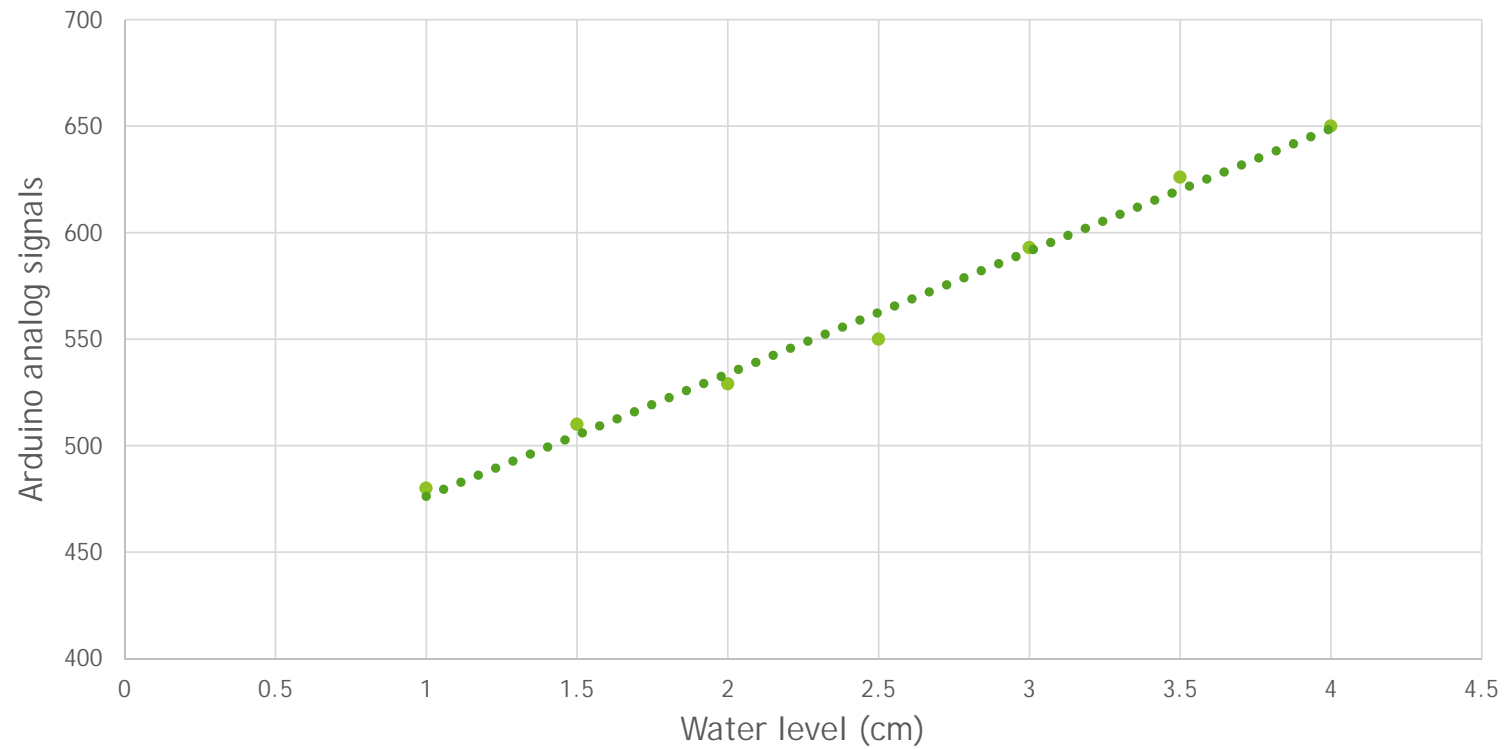
The image displays four screenshots of a mobile application interface, arranged in a 2x2 grid. Each screenshot shows a different health condition result for 'Volume' and 'pH'.

- Top Left Screenshot:** Titled 'Health Condition', it features a large 'Smiling Face with Happiness' emoji (😊). Below the emoji are two buttons: 'Update' and 'More'. The status bar at the top shows 30° and 50% battery.
- Top Right Screenshot:** Titled 'Volume', it shows 'Daily:Low' and 'Real-time:Low' in red boxes. Below these are 'pH:Normal' and 'Color:Colorless' in green boxes. A green message reads 'Urine condition is health, keep it up!'. At the bottom are buttons for 'Update', 'Questionnaire', 'Contact doctor', and 'Back to main menu'. The status bar shows 下午5:18 and 48% battery.
- Bottom Left Screenshot:** Titled 'Health Condition', it features a large 'Smiling Face with Mask' emoji (😷). Below the emoji are two buttons: 'Update' and 'More'. The status bar at the top shows 29° and 48% battery.
- Bottom Right Screenshot:** Titled 'Volume', it shows 'Daily:Low' and 'Real-time:Low' in red boxes. Below these are 'pH:Alkaline' and 'Color:Yellow' in red boxes. A red message reads 'Urine condition is not good, please do the questionnaire.'. At the bottom are buttons for 'Update', 'Questionnaire', 'Contact doctor', and 'Back to main menu'. The status bar shows 下午5:18 and 48% battery.



The Arduino color sensor and standard colorimeter shows **linear relationship** in different level of iron (III) nitrate concentration.

## Analog signals of **water level sensor** under different water levels



The water level and the analog signal shows **linear relationship**.

# pH Sensor

pH value of standard buffer solution	3	4	5	7	9	10
PH-206	3.01	4	5.04	7.01	8.84	9.99
% Error	0.33	0	0.8	0.14	1.78	0.1
Our Sensor	2.89	3.87	5.01	6.88	9.12	10.23
% Error	3.67	3.25	0.20	1.71	1.33	2.30

The % error of between pH-206 and our sensor is less than 4%.

# Advantages

- User-friendly & convenient
- Provides continuous data monitoring
- Low cost

# Demo

Press the button



Urine will be pumped into testing box



Sensors will receive and upload testing data



Water will be pumped into urine reservoir to clean the reservoir



Urine discharge



Water will be pumped into the testing box and clean the box



Water discharge


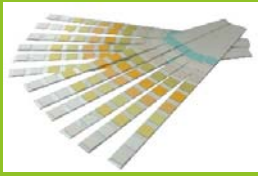



# Cost evaluation

Microcontroller	pH meter	Color meter	Water level sensor	Pumps	Waterproof box	Installation
\$20	\$15	\$8	\$1	\$6	\$20	\$10

**TOTAL US\$80**

## Comparison with commercial available products and services

	 <b>KIDNEY</b>		
Cost	US\$80	US\$2 /test	US\$200 /test
Feature	<ul style="list-style-type: none"> <li>• Accurate</li> <li>• Fast</li> <li>• Quick and easy installation</li> <li>• Home-checking</li> <li>• Convenient</li> <li>• 24/7 data that can be shared with doctors</li> <li>• Multiple use</li> </ul>	<ul style="list-style-type: none"> <li>• Disposable</li> <li>• Difficult to read and understand the result</li> <li>• No online platform to share and store data</li> </ul>	<ul style="list-style-type: none"> <li>• Expensive</li> <li>• Need to stay in the hospital for observation</li> </ul>

## The Next Step

- ▶ Have multiple sizes
- ▶ Measure urine glucose and protein
- ▶ Promote to elderly centres