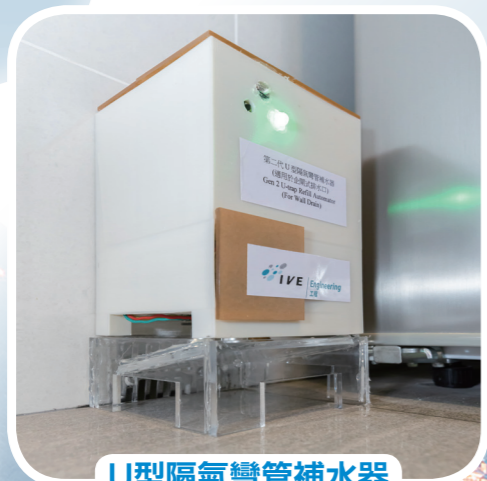


以創新思維研發裝置 市建局推動「智慧抗疫」

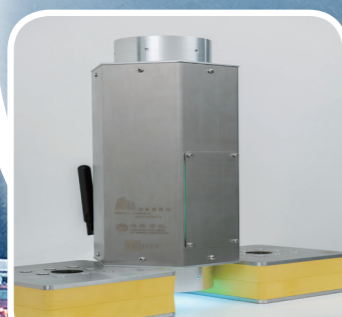
URA Helps Combat COVID-19
with Smart Innovations



U型隔氣彎管補水器



「健康碼」2.0



天台通風管紫外光消毒裝置



無扇葉通風裝置

一場世紀疫症，令全球大受影響。面對新常態下的種種挑戰，世界各地都在絞盡腦汁抗疫，迎難而上。一直以來，市區重建局（市建局）在不同市區更新範疇均積極應用創新科技；在抗疫上，更銳意運用創新思維，連結業界伙伴，配合物聯網及大數據等科技，研發出能提升樓宇和居住環境健康質素的設備，實行智慧抗疫。

因此在不久將來，無扇葉通風裝置可為重建後的觀塘居民帶來更清新的空氣；天台通風管紫外光消毒裝置及U型隔氣彎管補水器，則猶如兩大護衛，守護屋宇喉管的衛生安全；感染風險提示程式「健康碼」2.0，會提醒市建局職員遠離疫廈，兼可展示職員的病毒檢測結果，進行凍結人口調查時令居民更安心。市建局期望這些創新科技，能造福不同階層，增加各行各業的免疫力，並且推動社會以智慧科技應對未來挑戰，令市民生活得更安心更健康。

The COVID-19 pandemic has disrupted the whole world in unprecedented ways. In the face of challenges under the new normal, every country is working resiliently to combat the disease. Having been adopting innovative technology at various fronts, the Urban Renewal Authority (URA), in collaboration with industrial partners, strives to develop innovative devices adopting advanced technologies like Internet of Things (IoT) and big data applications to improve buildings hygiene and uplift the quality of living environment.

Hence with Air Induction Units in the near future, more fresh air can be brought into the redeveloped communal facilities benefitting residents of Kwun Tong; with UVC (Ultraviolet-C) sterilisation device for the vent pipes at roof levels and the U-trap Refill Automator, households are protected against the passage of virus through the drainage pipes; and with "Health Code" 2.0 the mobile alert application, URA staff can avoid being exposed to buildings with COVID-19 infections, and show their virus test results to residents during freezing surveys offering greater assurance to the public. It is with the hope that these smart technologies can benefit different businesses as well as people from all walks of life by providing solutions for future pandemic challenges, thus enhancing the society's overall capability to fight against the virus.



市建局「健康碼」2.0應用程式，透過GPS全球定位系統，結合政府公布的確診個案大廈名單，讓市建局職員清楚掌握附近疫廈的資料。

Incorporating the list of buildings with confirmed COVID-19 cases announced by the Government and facilitated by the Global Positioning System (GPS), the "Health Code" 2.0 mobile app alerts staff to the buildings affected.

感染風險提示程式 市建局推「健康碼」2.0

URA Alerts Staff to COVID-19 Exposure Risk with “Health Code” 2.0

市建局每當宣佈推展重建項目時，會同步在項目範圍內進行凍結人口調查。市建局職員需要到居住單位與戶主面談，全面和準確地掌握物業使用狀況和記錄單位住戶的身分，確保調查的準確性。可是在疫情陰霾下，即使只是簡單接觸亦可構成風險。處理舊區老化刻不容緩，如何在逆境中繼續推動市區重建，曾經是個難題。

為此，市建局去年底研發出全新的感染風險提示程式「健康碼」，透過GPS全球定位系統，結合政府公布的確診個案大廈名單，提示職員避免進入疫廈，同時能展示職員的陰性檢測結果，令市民安心面談。市建局「健康碼」自推出後大獲好評，更將於今年年初公開2.0進階版，除了加強私隱保障外，更加入掃描「安心出行」場地二維碼的功能，以及新增「綠、黃、紅」三色類別顯示，令程式更方便易用。

負責研發的市建局高級經理（資訊科技）劉玉寶（Jack）稱：「抗疫是全城的事，大家都想盡一分力。我們深信自家研發的『健康碼』2.0可以起示範作用，集結經驗與政府及業界分享，大家取長補短，一起抗疫。」

隨身的自我保護裝置

初始版的「健康碼」早於去年十月推出，適值開展旺角山東街 / 地土道街的重建項目，市建局人員須造訪該區一帶的舊樓，挨家挨戶進行凍結人口調查，以核實受影響人士身份。當時新冠疫情仍未受控，為確保調查員及受訪市民的安全，市建局於是自行研發「健康碼」，用來向居民展示調查員的深喉唾液檢測陰性結果。程式亦記錄了職員過去七天的行蹤，並時刻因應調查員所在的位置提出警示，若二百米內有確診或疑似新冠肺炎個案的大廈，程式便會發出提示，提醒他們要遠離疫廈，以策安全。

作為研發者及用家，Jack大力推介程式優點：「有次我工餘時去旺角購物，原來一街之隔竟有三幢疫廈！幸好『健康碼』程式及時響號並發送提示給我，讓我避開危險地帶。試想想，市建局的人口調查往往動用百多名同事，如果其中一個染疫，整個項目都要停頓，所以同事們都很理解，也願意配合。」



程式顯示「綠碼」，代表職員持有陰性深喉唾液檢測結果，而且從未進入疫廈。

The green codes are for URA staff who are tested COVID negative and have not entered buildings with infection cases.

三色風險提示

話雖如此，為加強同事的私隱保障，市建局亦不斷改良「健康碼」程式。Jack解釋：「經提升後的進階版2.0，個人資料將只會留在手機內，同事亦可在接收風險提示後，直接輸入備忘，填報到訪疫廈的目的、到訪的單位和曾接觸人士等，以備不時之需。而所有疫廈的資料，亦會以地圖顯示，並增設搜尋功能，一目了然，方便閱讀及查找。」

「健康碼」2.0亦會加入「綠、黃、紅」三色類別顯示，當職員使用程式作健康申報時，若持有陰性檢測結果且不曾進入疫廈，會展現「綠碼」，以示安全；若程式偵測到其曾逗留在具病毒傳播風險的建築物，便會自動轉作「黃碼」。一旦成為確診者，他們可透過程式進行健康申報，將風險等級升至最高級別的「紅碼」。



Jack期望「健康碼」能幫助同事在疫情下生活得更安心。Jack hopes the "Health Code" mobile app can offer greater assurance to colleagues who need protection from infection risk.



當公布重建項目，市建局人員須造訪該區一帶的舊樓，挨家挨戶進行凍結人口調查，因此須確保自身免於感染風險。It is vital to ensure URA staff are protected from COVID-19 infection risk before and after conducting freezing surveys on the commencement of redevelopment projects.



「健康碼」應用程式，讓市建局職員可向居民展示新冠肺炎的檢測結果。

A URA staff reassures a tenant of her health condition by showing the negative COVID test result with the "Health Code" mobile app.

市建局已安排約50名負責調查工作的職員，率先安裝「健康碼」2.0版。程式將在凍結人口調查前14天開始運作，並配合佩戴連接程式的智能手環，預早提示職員在調查前後，避免進入有病毒感染風險的建築物，做好風險管理。

Jack說：「我在市建局工作多年，曾參與多個資訊科技項目的改良及研發，但以今次經驗最為深刻。因為『健康碼』程式的開發，不只為確保項目順利開展，亦為了抗疫工作出一分力，意義重大。」

室內定位方案續測試

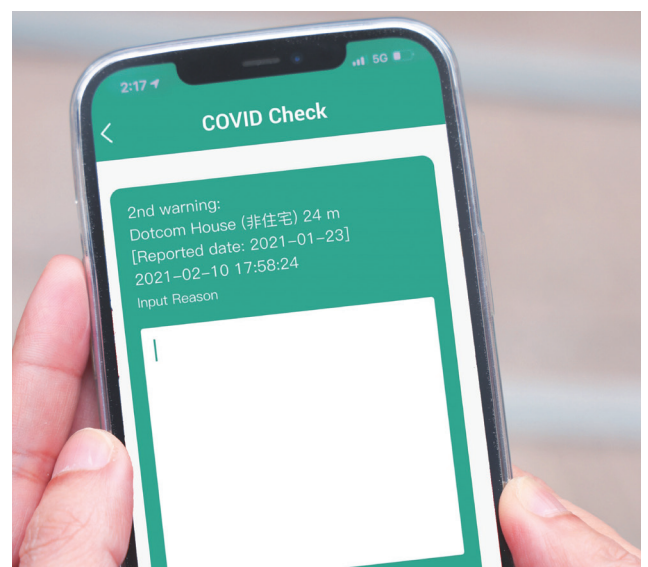
不過，程式利用全球定位系統（GPS）運作，要在室內地方閱讀到精準的定位，仍有待進一步研究。Jack稱：「我們正嘗試幾個不同方案，例如考慮利用藍芽，把手機變成『發射站』。舉個例子，只要有智能電話開啟程式，就可變身信號傳送器『iBeacon』，透過藍芽，把室內資料發送到其他同事的智能電話中，確認位置。」還有其他室內定位方案，團隊還需要更多時間去測試。

至於加強保護同事私隱，以及新增三色類別健康顯示的「健康碼」2.0則會於今年首季推出，供全體市建局職員試用。Jack說：「我們從小社群開始，看是否行得通，再把經驗分享給政府或業界，希望最終能惠及大眾。」

On the commencement of redevelopment projects, the URA would conduct freezing surveys with affected tenants. While it is important to safeguard the health of both the interviewers and the affected tenants in the project area during the pandemic, the URA has developed the "Health Code" mobile app to send alerts on potential COVID-19 exposure. With the app, interviewers can also show their negative results of Deep Throat Saliva Test to tenants. Incorporating the list of buildings with confirmed COVID-19 cases announced by the Government and facilitated by the Global Positioning System (GPS), the app generates alerts to remind staff not to enter the buildings affected. Notifications will be sent when they are within 200 metres of a building with confirmed or probable cases of COVID-19, so they can keep a distance and remain safe.

The URA's "Health Code" app has been well received since its launch. An upgraded version 2.0 will be released early this year, offering more assurance on the protection of privacy and a more user-friendly interface which displays data of the affected buildings in map view with search function. The upgraded app version will also enable tenants to track the health reporting status of the URA staff through a three-colour display of green, yellow and red.

To tackle the problem of indoor positioning, the team is now considering different options, including the use of Bluetooth to transfer indoor location data to other smartphones. According to Jack Lau, Senior Manager (Information Technology) of the URA, more tests are needed to be run to ensure accuracy. "We are pleased to share our experience with the Government and the industrial partners. Together we can complement one another's effort in combating the virus."



市建局職員在接收風險提示後，可直接輸入備忘，填報到訪疫廈的目的和曾接觸人士等，以備不時之需。

After receiving the COVID-19 exposure risk alert, URA staff are able to record details of their visits with the app including locations and persons they have come into contact with.

由十個AIU組成的接力式通風裝置，可由外面引鮮風到交匯處，令送風效能發揮到極致。
Comprising a total of 10 AIUs, the ventilation device is able to optimise the performance of the innovation in relaying fresh air to the semi-confined transport interchange area.

趕走觀塘裕民坊廢氣 無扇葉通風裝置

Fume-free Public Transport Interchange A Dream Come True in Kwun Tong With Bladeless Air Induction Units

香港半封閉式的公共運輸交匯處，在酷熱天氣下常常變成「焗爐」，令排隊候車的市民透不過氣來，在疫情下更有機會助長病毒的傳播。有見及此，市建局在即將啟用的觀塘裕民坊公共運輸交匯處，引入本地研發且獲獎無數的無扇葉通風裝置（AIUs, Air Induction Units），能有效導入多達十倍的新鮮空氣，加強空氣流通，令公共運輸交匯處不再「廢」氣沉沉。

位於裕民坊的公共運輸交匯處，是觀塘市中心計劃的新建設施之一，預計在今年四月啟用。巴士站設在交匯處的上層，乘客可在冷氣候車區內候車；至於十九條小巴線車站，則設在下層的半封閉式空間內。屆時區內所有小巴站都會搬移到交匯處，預計人流不少。

市建局工程及合約高級經理楊雲傑（Tenny）說：「這交匯處依着觀塘的高低地勢而建，小巴站由於位處物華街地面以下空間，本來鮮風就不易進入。為了解決這個問題，我們除了安裝標準的通風設備外，還特意與合作發展商一起構思，邀得工程顧問公司奧雅納的香港團隊合作，在他們的得獎設計之上，研發出嶄新的強力通風系統，讓這個『本地薑』設計發揚光大。」

接力式加強送風

無扇葉通風裝置（AIU）外形像飛機翼，主要利用空氣動力學原理，透過改變空氣的流向，在連接傳統通風系統後，出風口可以送出高速氣流，從而帶動大量周邊空氣穩定而均勻的流動；與傳統機械式風扇相比，AIU可導入空氣流量達十倍，最高可減少65%的耗能量，舒適節能之餘，也把噪音降至最低。

至於位於裕民坊公共運輸交匯處的通風系統則是「加強版」，由兩列五排共十個活像飛機翼的AIU組成，置於連接物華街地面與底層小巴線車站的自動扶手電梯頂部。這樣，鮮風便可由一排排的裝置接力，從物



（左起）Gary、Tenny及Jimmy代表着香港不同界別，合力用創新思維及科技，把觀塘區打造成一個更宜居的地方。

（From left）Adopting innovation and technology, the collaborative effort from Gary, Tenny and Jimmy and their respective sectors has made the redeveloped Kwun Tong a more liveable area.

華街地面引導至下層的小巴車站。為了加強通風效果，工程團隊又在公共運輸交匯處連接物華街的地面位置，額外加裝了兩部AIU。

奧雅納工程顧問湯振權（Jimmy）指：「AIU的原型已在元朗多功能社區中心及香港其他幾處半戶外空間應用，但一般都是單個式運作。今次是首次安裝在公



裕民坊公共運輸交匯處依着區內高低地勢而建，如何引入更多鮮風到下層的小巴士站，是設計的一大挑戰。

Built on a sloping site in Kwun Tong, the public transport interchange at Yue Man Square has split levels, making entry of fresh air to the lower floor a very challenging task.

共運輸交匯處中，而且突破性地用了多組『機翼』裝置作接力式送風，效果更為顯著，能把環境溫度降低攝氏1.5至2度。」這個嶄新設計已先後獲得香港工商業創意大獎、香港環保建築大獎等五個獎項，並已在英國及香港申請專利。

與環境融為一體

設計團隊與時間競賽，由構思到落實概念只用了六個月，Jimmy笑說：「以科研項目來說是極快了！」最大的挑戰，是如何把AIU的效能發揮到極致。「我們透過大量電腦模擬計算及測試，評估在不同天氣、風速、風向、人流、車流等狀況下，裝置所能發揮的效用。最後發現用串連的模式，分兩列五組去裝設那些AIU『機翼』，由外面引鮮風到交匯處，送風效能最



通風扇藏於扶手電梯頂部上蓋。

Ventilation fans are hidden inside the escalator canopy.

大。事實上，每隻『機翼』的長闊、間隔、角度都經過精密計算。」

接着就要思考如何把通風裝置融入環境。除了美觀及安全因素，也要符合屋宇署的規定。「團隊想了很多方案，最後決定把設計融入扶手電梯上蓋，多隻『機翼』沿電梯平衡排列，風機連喉管則藏在玻璃上蓋內，基本上跟環境融為一體。」

信和置業發展部機電工程總經理陳立德（Gary）則表示：「位於觀塘市中心計劃的商場設施將是全港首個設有Wi-Fi 6覆蓋的地方，我們稍後可加入物聯網等技術，按天氣及人流等遙控通風系統，節能之餘，又可提升市民的生活質素。」

新冠疫情下，公共空間的空氣流通變得更為重要。Jimmy形容：「香港天氣又濕又熱，人煙稠密，這裝置可以把更多鮮風引入行人空間，改善空氣質素，並減少病毒傳播的機會，希望日後能在更多地方應用，在抗疫路上出一分力。」

Tenny則稱：「市建局也在積極考慮把這裝置運用在其他項目上，如商場及公共空間等，特別是抗疫時刻，希望這裝置能為市民帶來更衛生舒適的環境，願我們都有健康的體魄迎接每個新挑戰。」

On scorching summer days, semi-confined public transport interchanges (PTI) in Hong Kong are usually hot and stuffy, where lining up for buses and minibuses has become an unpleasant experience. What's more, the environmental conditions may favour the spread of viruses during the pandemic. In view of this, the URA has introduced an award-winning local invention – the bladeless Air Induction Units (AIUs) – into the soon-to-open public transport interchange at Yue Man Square, Kwun Tong. Capable of inducing up to 10 times of air movement as compared with conventional mechanical fan systems, the AIU can improve airflow and reduce the amount of exhaust fumes in the transport interchange area.

Built on a sloping site in Kwun Tong, the public transport interchange at Yue Man Square has split levels, the lower level of which houses the minibus terminal and is sunken below ground, making entry of fresh air difficult. In order to solve the problem, the URA worked in collaboration with the joint venture developer and engineering consultant to come up with an innovative bladeless ventilation design comprising AIUs for inducing airflow to the transport interchange.

The AIU has the shape of an aircraft wing and operates under the principle of aerodynamics to steer the direction of airflow. When connected to a ventilation system, the AIU generates a small jet of air, which in turn entrains a large volume of surrounding air. Compared to conventional mechanical fans, the AIU can generate 10 times the airflow while reducing up to 65% of energy consumption, making it a more comfortable, energy-saving and noise-reduced option.

To further increase airflow, the enhanced design of the air ventilation system at Yue Man Square public transport interchange comprises a total of 10 AIUs, which are arranged in two rows above the escalator connecting Mut Wah Street on the ground-level and the sunken level of minibus terminal.

A continuous flow of fresh air can then be relayed by the rows of AIU blades from Mut Wah Street down to the semi-confined minibus terminal area. To boost the ventilation performance, the team has also installed two additional AIUs on the ground level of Mut Wah Street. The whole system effectively reduces the temperatures inside PTI by 1.5 to 2 degrees Celsius.

設計成機翼模樣的送風系統，裝置於扶手電梯上蓋，與環境融為一體，可見設計者的心思。Having the shape of aircraft wings above the escalator, the AIUs are designed to integrate with the surrounding environment.





經改良的補水器有2.5升大水箱設計，可減少入水次數。

The new version of the device is equipped with a larger storage tank so that users can refill the water tank less frequently.

全天候家居守衛 U型隔氣彎管補水器

U-trap Refill Automator Guards Against Virus Spread

累積了新型冠狀病毒及多年前沙士的抗疫經驗，香港人對U型隔氣彎管都不會感到陌生；定期注水入U型聚水器，是家居抗疫的重要防線之一。香港專業教育學院（IVE）的師生團隊，去年研發出一個方便易用的自動補水器，讓老人家或行動不便的人士都能確保U型隔氣彎管有足夠的水封，阻隔病毒入屋。這個嶄新的設計早前在市建局的比賽中奪得金獎。

為協助團隊進一步改善設計，市建局除安排空置單位給師生們作實地測試外，亦提供有關渠管及排水設計等專業意見，務求研發出更全面實用、適合大部分家庭使用的渠管自動補水裝置。因應近日多區舊樓爆發疫情，在與IVE團隊商議後，市建局已聯絡廠商為這項設計投產，預計第一批二千個補水器，將於今年年中送到四幢安置大廈單位，以及在重建項目中已收購的物業，供約二千個住戶使用，加強他們的家居免疫力。

市建局工程及合約部高級經理許穎麟（Elvis）說：「抗疫路上大家都可以出一分力，這個補水器正好切合時代的需要，我們希望把補水器的成本控制在二百元以內，日後能令更多市民受惠。」

實地測試後的改良版

自動補水器的裝置及操作其實非常簡單，市民只需把小盒子般的補水器放在家居的排水渠口，並在儲水格注滿水，內置的超聲波便會自動偵測渠內的儲水水位高度，若發現低於安全水平，便會將訊號傳送到電子控制板，「命令」補水器向隔氣彎管注水。

香港專業教育學院工程學科項目主任洪健豪（Benson）稱，這是本地原創設計，坊間並無類似裝置可參考，從選料、設計，到科技應用等都得由零開始，並要符合香港法例對喉管的

嚴格規範，因此研發過程像摸着石頭過河。「感謝市建局提供不少舊樓單位給我們進行水位監察、自動注水效能等實地測試，讓我們發現原有設計的局限，並針對現實環境及需要不斷改良。」

譬如渠口的設計，第一代自動補水器本來只適用於地台式渠口，團隊走訪舊樓單位後，才發現原來香港大部分住宅均採用企閘式設計，便因應需要改良設計。此外，新設計亦選用了較高身的大水箱，增加儲水容量，每次注水可足夠使用約五個星期；又為「補水器」的注水口加裝一條接駁喉管，伸延到地台渠閘，



香港專業教育學院的師生團隊研發出自動補水器，為居家抗疫的市民帶來一大方便。左起為香港專業教育學院工程學科講師杜璟庭、學生楊凱棋、何嘉文，和香港專業教育學院工程學科項目主任洪健豪。

(From left) Hong Kong Institute of Vocational Education (Sha Tin) Department of Engineering Lecturer Kelvin To, student Tom Yeung, Bonnie Ho, and Workplace Learning and Assessment Project Team (Engineering Programmes) Project Officer Benson Hung work together to invent the "U-trap Refill Automator".

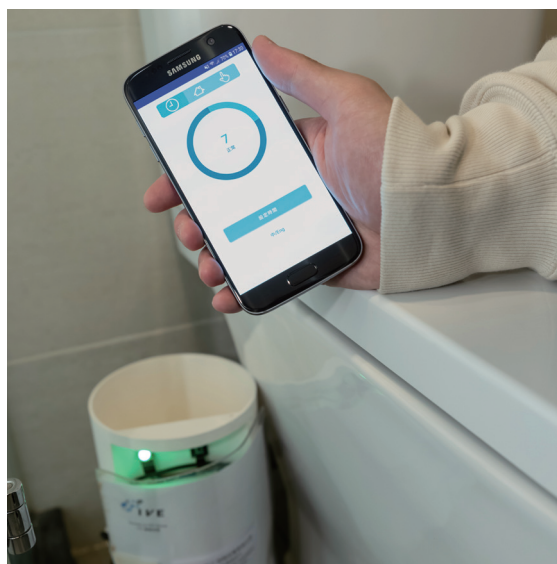
「補水器」便可放置在洗手台附近，用起來更簡便。改良後的「自動補水器」使用一般乾電池，不需要額外接駁電源，住戶只需將補水器放在排水渠口上啟動便能夠運作，即使是渠管設施較老舊的單位也可使用，毋須進行喉管改裝工程。

市建局為「基本版」投產

考慮到引入裝置需以便民為原則，因此市建局把即將投產的自動補水器定為「基本版」——內置計時功能，以定時自動注水模式運作，確保彎管有足夠水封來阻隔病毒。儲水箱亦加設水位感應器及顯示燈，當裝置的儲水量降至一定水位時，顯示燈便會亮起，提示用戶為儲水箱注水。

此外，IVE團隊還在其第二代設計的研究中加入不少創意元素，例如利用物聯網技術，使用戶可以透過手機應用程式進行預設及遙距控制，全天候監測U型隔氣彎管的狀況，並可選擇自動或手動補水。系統還會透過應用程式，以短訊及電郵提示用戶加水入儲水格。

香港專業教育學院（沙田）工程系學生楊凱棋說：「我們實地測試發現某些樓宇的網絡接收欠佳，應用程式上某些功能無法使用，因此想出為補水器加設LED燈，顯示補水器的狀態，例如綠色代表正使用超聲波偵測水位，紫色則代表已設為定時模式，一目了然。」



利用物聯網技術，用戶可透過手機應用程式，監測彎管的水位，非常方便。

Having adopted IoT technology, the second generation of the device can display water levels inside the U-trap on mobile phones.



補水器只有小盒子般大，一般可貼着渠口擺放，用戶只需每三星期至一個多月不等加水一次，非常方便。

Users need only to place the box-like apparatus near the drain and fill the storage tank with water once in every three weeks or a month, then the ultrasonic sensor will automatically detect the water level in U-traps and “command” the “U-trap Refill Automator” to release water into the pipes when the water level drops below a certain low point.

他的同學何嘉文則笑說：「我曾當過義工教長者用手機，知道應用程式的版面要盡量簡潔易讀，結果用了一個大圓形來顯示隔氣彎管的水量。水位夠不夠高，要不要注水，一望就清楚了。」

發明家的使命感

自從補水器的設計曝光後，學院接獲不少市民來電。有的表示期待，急着查問出售日期；有的提建議，分享自己對新設計的見解；有的則閒話家常，傾訴自己對疫情的擔憂；有的甚至想洽談合作。Benson笑說：「有市民把自己家中洗手間的相片電郵給我，說擔心喉管滲漏，影響家人健康。也有市民大讚有了

這裝置後，將來去旅行也安心得多。作為設計者之一，真的很有滿足感，希望大家都能在新常態下如常生活就好。」

疫症來襲，能運用自己的專業來守護這城市的，還有另一位拍檔——香港專業教育學院工程學科講師杜環庭（Kelvin），「從小到大我都想研究一些新發明來幫助人類。研發期間我們常聽到有大廈懷疑經U型隔氣彎管播毒，感覺更有使命感，師生都日以繼夜希望儘快完成，以減少病毒傳播的機會，滿足社會的迫切需要。」

Floor drains with U-traps are no strangers to Hong Kong people who have experienced the pandemic outbreaks of COVID-19 and SARS. Ensuring U-traps to be regularly filled with water is one of the important defences against the spreading of diseases at home. Last year, an easy-to-use “U-trap Refill Automator” was invented by a group of teachers and recent graduates of Institute of Vocational Education (IVE) to help elderly and people with disabilities seal their U-traps with adequate water thus preventing viruses from entering their homes. This innovative design has won the Gold Award at the URA’s Innovative Design Competition.

A user-friendly device, the “U-trap Refill Automator” only requires users to place the box-like apparatus near the drain and fill the storage tank with water, then the ultrasonic sensor of the device will automatically detect the water level in U-traps. Once the water level falls below a certain low point, a signal will be sent to the electronic control panel, which will then “command” the device to release water into the pipes.

In order to assist the IVE team to further improve the design, apart from providing some vacant units for them to conduct on-site trials, the URA has also given them professional advice on the design of drainage pipes. As a result, the “U-trap Refill Automator” has been enhanced with some new features that can fit both the wall and floor drains. Moreover, the new version

is now equipped with a larger storage tank so that elderly users can fill the water tank less frequently.

In response to the recent outbreak of COVID-19 in many old buildings, the URA has decided to commission the production of the basic version of the U-trap Refill Automator after discussing with the IVE team. Equipped with a built-in timer function, the device would automatically fill the U-trap with clean water at regular intervals to ensure that the U-trap is maintained with water seal to prevent the spreading of virus. The water storage tank is also fitted with a water level sensor and indicator light. When the water storage capacity of the device drops to a certain level, the indicator light will be switched on to remind the user to refill the water tank. The URA expects the first batch of 2,000 U-trap Refill Automators to be delivered to and applied in units of the four rehousing blocks as well as the properties acquired under redevelopment by mid-2021.

In addition, the IVE team has added a lot of creative elements in the design of their second-generation device, such as the use of IoT technology to enable users to preset and remotely control it through mobile apps, monitor the U-trap around the clock and allow users to choose between automatic or manual mode of water refilling. The system can also remind users to refill water in the storage tank via SMS and email.

不可不知的水封小知識

接連有大廈爆發疫情，家居渠管的衛生安全不容忽視。其中最常提及的U型隔氣彎管，是連接單位衛生設施與大廈公用排水管的裝置，它有一項極為重要的任務——透過水封（water seal），即彎管內一定高度的水柱，阻擋病毒經喉管竄入單位。

我們日常排放污水，例如沖廁時，喉管會產生負氣壓，將隔氣彎管內的水封吸走。乾燥的天氣、喉管破損滲漏等因素，都可能導致水封流失。因此，如何確保彎管內有足夠儲水形成有效水封，極為關鍵。最簡單有效的方法，就是定期為U型隔氣彎管補水。

一般新建成的樓宇單位，已於渠管系統加入防止水封流失的設計，例如在彎管加設一個用作平衡水管氣壓的反虹吸氣閥，又或使用W型隔氣彎管等，可視為「被動式」補水。舊式樓宇的隔氣彎管則一般都沒有防範水封流失的裝置，只能採取「主動式」補水，即如政府所呼籲，市民應每星期向所有排水口傾注約半公升清水，以確保水封運作正常。





在天台通風管上安裝紫外光消毒裝置的模擬圖
Simulated image of installing the UVC sterilisation device on a rooftop ventilation pipe

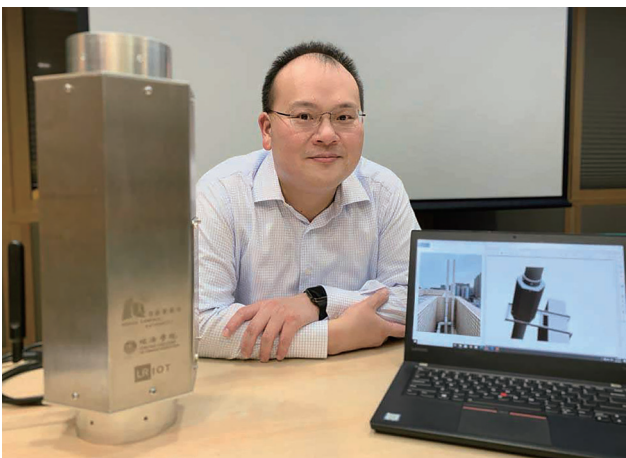
病毒淨化 天台通風管紫外光消毒裝置

UVC Sterilisation Device Fends Off Virus Transmission Through Pipes

去年三月，大埔富亨邨亨泰樓爆發新型冠狀病毒疫情，專家團隊視察後懷疑是天台通風管因「擾流效應」播毒，令市民再次關注樓宇喉管的衛生安全。為減低喉管播毒的風險，市建局特別聘請專家團隊，為位處天台的大廈通風管研發及安裝UVC紫外光消毒殺菌裝置，確保經大廈喉管排出的空氣都淨化無菌，保障市民健康。

受委託負責研發的珠海學院土木工程學系副教授林振宇稱：「香港高樓大廈的天台滿佈喉管，在疫情期間，每一條喉管都可能是散播病毒的渠道。經浸會大學生物學系測試，紫外光消毒裝置可有效殺滅喉管中八至九成病毒，其中包括新型冠狀病毒，成效顯著。透過應用這技術，我們希望可堵塞這個傳播病毒的途徑。」

市建局工程及合約部高級經理許穎麟（Elvis）說：「市建局在取得政府相關部門的批准後，便會在中環街市活化項目及鼓油街安置大廈天台實地測試，收集有關排水通風管裝置發揮消毒效能的數據，再作調整，希望未來可在活化後的中環街市投入運作。」



林振宇教授指出，團隊最後選用UVC紫外光來殺菌，是因為它既方便又節能。

Prof Lam Chun-yu says the team decided to adopt UVC as the disinfection method due to its convenience and effectiveness in energy saving.

有效殺滅新冠病毒

新研發的UVC紫外光消毒裝置，用於與糞渠相連的通風管出口處。通風管的作用是疏通排水系統的氣流，防止發生「虹吸作用」（siphon effect or siphonage）——由於大廈住戶的座廁接連同一糞渠，當其他樓層沖廁時，產生的負壓可能會抽走U型隔氣彎管內的水，這時外面的空氣就會經由天台的通風管進入，平衡氣壓。

林教授解釋：「所以一般而言，天台的通風管是用來吸氣而非排氣的，但如果凌晨時份沒人沖廁，剛巧渠口又有風吹過形成擾流，氣體或會逆向排出大廈外，大埔疫廈的狀況可能就是如此。」

用UVC紫外光殺滅空氣中的細菌，可靠而節能，早已廣泛應用於生活上，然而應用在樓宇的通風管上，在香港則屬首次。研發團隊需要克服消毒效能、建築法例規限以及維修保養等各種挑戰。

通過多項效能測試

在消毒效能方面，團隊做了一系列的測試。他們先委託浸會大學的生物學實驗室進行消毒測試，以UVC紫外光照射一些與新冠病毒結構相似的病毒樣本，以了解這技術用於消滅新冠病毒的效能。首階段測試結果顯示，UVC紫外光可以有效破壞病毒樣本，遏止病毒傳播。

此外，團隊亦因應通風管內的氣體排放速度，進行一系列氣體流動測試，以調校合適的UVC射線能量水平，確保紫外光裝置的強度足以淨化通風管內的污濁氣體。

身輕耐用高智能

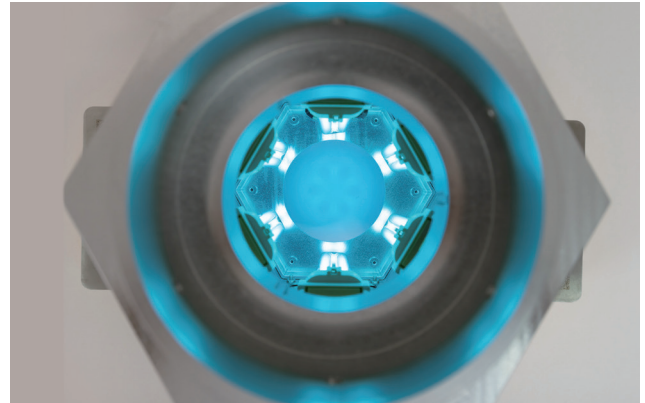
至於維修保養方面，林教授解釋：「為免增加喉管的負擔，影響正常運作，加裝在天台通風管的紫外光消毒裝置不能太笨重，我們選用了輕身耐用的防鏽金屬物料，重量還不及一部窗口式冷氣機。設計也由最初比較肥肥矮矮的模樣，改良成為現在瘦瘦長長的六角柱體。」

而為了確保裝置可抵禦本港夏季的高溫和較大的日夜溫差，團隊選用上耐熱度達攝氏85度的零件。裝置外殼上亦預留了一個維修窗口，方便技術人員檢查及更換零件。此外，裝置的溫度、UVC射線強度和使用狀態等運作數據，亦可通過物聯網技術傳送到樓宇設施管理系統，讓物業管理人員時刻掌握消毒裝置的運作及損耗情況，適時安排保養維修。

林教授解釋：「紫外光消毒裝置內幾個感應器，可收集數據以監察各紫外光燈的強度，進而推算使用壽命，以便更準確制定維修時間表。譬如在流感高峰期的前夕，我們可因應需要預先更換內置的紫外光燈，確保其處於最佳狀態。此外，我們也可以透過收集風速數據，調節紫外光燈的亮度來節能。」

此外，鑑於《建築物條例》對通風管的大小直徑及防漏氣要求有嚴格規定，並要求確保通風管不會洩漏氣體，因此團隊經過細心考量後，決定在消毒裝置外加設一個支撐架，減低通風管需承托裝置重量的壓力，並在所有縫合位置加裝防漏氣膠墊，以確保零洩漏。

Elvis稱：「自從通風管紫外光消毒裝置的設計曝光後，業界反應正面，我們希望可起牽頭作用，令香港廠商主動研發更多適用於住宅及商業大廈的防疫設備和產品，遏止疫情，讓香港人可盡快回復正常生活。」



UVC紫外光消毒裝置切面圖
Cross section view of UVC sterilisation device

The outbreak of COVID-19 in the community, in particular the infection cases in Heng Tai House, Fu Heng Estate in Tai Po last March has once again raised concerns about the hygiene risks from drainage pipes. Experts suspected that the spread of virus was a phenomenon of the “wake effect” which might have occurred on the rooftop where air turbulence may bring the virus from the ventilating pipe outlets of soil and waste stacks into residential units. To lower the risk of infection arising from drainage pipes, the URA has invited and supported a team of experts to develop the UVC (Ultraviolet-C) sterilisation device for connecting with ventilating pipes on the rooftops to ensure all air vented out the building is sterilised.

The newly developed UVC sterilisation devices are connected to the ventilating pipe outlets of soil and waste stacks, whose purpose is to equalise the air pressure inside the drainage system to avoid the “Siphon effect” or “Siphonage”. As toilets of different units in a building are connected to the same soil and waste pipe, when someone flushes the toilet, the subsequent negative suction may drag water out of the U-trap. Hence it is important for air to flow in through the roof ventilating pipes to balance the air pressure and prevent the water seal of the toilet from being broken. Open to atmosphere, the vent pipe usually allows entry of air to make up for any reduction of air pressure in the drainage system, but when wind incidentally blows through the pipe end forming a turbulence, air carrying the virus may leak out from the soil and waste pipe.

Associate Professor of Civil Engineering Department of Chu Hai College of Higher Education Ronald Lam Chun-yu, who is also responsible for the project, said test results have proven that the UVC sterilisation device effectively kills 80 to 90% of the virus in pipes, including the novel coronavirus (tested by Pseudo virus). Elvis Hui, Senior Manager (Works & Contracts) of the URA said the Authority is seeking approval from Government departments to install the devices on the roofs of Central Market and Soy Street rehousing block for on-site trials. Performance data of the sterilisation devices are to be collected for further modification on the design before a full launch of the device will take place in the future.