Project Proposal CITS5506: Internet of Things

To be submitted by 11:59 pm on Thursday, 31 August 2023

1. Name of Project:

   Smart Multi-purpose Passerby Counting System.

2. Group Number, Names and Student Numbers of team members:

   Group Number: 40

First Name	***Last Name***	***Student ID***
Rongchuan	Sun	23715251
Brandon	Ke	22731448
Aryan	Radadiya	23851299
Yunwei	Zhang	23825634

3. Why ……Why you want to do this project. What benefit your project will bring?

   Ever since COVID-19, there have been restrictions for limited number of occupants in various places and environments. It is obvious that these restrictions have been imposed over time, with people being advised to be cautious of where they are and how busy their location is [1].

   In the case of public transportation, buses via public transportation usually have a limit to how many people are allowed on board. Sometimes, at specific locations and times, there may be too many people for a bus to take e.g., CBD during peak time. Whether it is to avoid hitting the limit of weight the bus can take or o reduce the risk of people contracting contagious illnesses, especially COVID-19, the bus will not be able to take everyone if there is a large group of them at one place.

   Hospitals have a crucial need to continuously monitor who enters them and how many people are currently there to avoid potential issues such as hospital-overcrowding [2]. Hospitals can have many people that have contracted different kinds of illnesses, whether it be acute or serious, with COVID-19 being one of them. Having too many

people located at one hospital increases the risk of spreading illnesses, which is why it is important to monitor the number of people entering or currently occupying the building. This data could prove to being useful if hospital staff were to analyse this information to make decisions that would decrease the likelihood of overcrowding.

In addition, it can also be widely used in other kinds of occasions like schools, events, roads, restaurants and so on. Since these places are all based on the data like how many cars would across this road in a period so that we can analysis the percentage of traffic jam, whether it is necessary to add more traffic lights or broaden the road. Also, in the case of restaurants, it would be more effective that we can know what period of time, which date or which branch will have more customers, thus we can allocate more staff, speed up food delivery or other methods that may make operations more efficient.

If we can create a system that detects and counts the number of people that through some gateway or door [3] over time and at any location, interested parties may be able to use that system to make decisions in the future to help monitor the number of people that gather to one place to ensure that the limit of people allowed there at the same time is not exceeded to help reduce the risk of spreading COVID-19. There are already existing systems for public buses that count the number of people that get on to a bus during by using IR and FRID sensors [4] [5]. We would like to create a variation of those systems that not only explores different types of sensors, but also expand the selection of applications and environments it can be deployed at.

4. What ……What is the problem you will solve? What benefit your solution will bring? What is its impact (How big will be the impact for example in terms of numbers of people, financial etc?)

   The project aims to solve various problems depending on the application it will be used for and the environment it will be deployed at. The proposed system will have the capability of recording the number of people that pass through it and track the current number of people that are currently residing at the deployed location, which gives it an expansive and flexible selection of applications for it to be used for. With COVID-19 becoming prevalent since 2020, there may be more people in society are becoming aware and cautious about the number of people occupying the same location. They may even need to use analytics based on the information transmitted by the system to help make predictions that can help answer questions such as “when should they expect a large influx of people coming in.”

   Public buses are an example of an application the system can be used for. Every bus has a limited capacity. To utilize their capacity in the best possible way, we need some sort of technique to know how many people are there in the bus at particular moment of

time. Moreover, we also need to know how many people are waiting on a particular bus route. So that we can send more buses when need them on a route.

For hospitals, it was previously stated that it is crucial that the number of people entering and exiting is monitored to ensure the max capacity of occupants is not reached. This was because by increasing the number of people in the same place where patients of various contagious illnesses, with COVID-19 being one of them, the risk of these sicknesses spreading is also higher. Hospital staff may find it helpful to monitor how many people are entering at specific times of days so that they could take precautions to deal with large groups of people coming on the same day e.g., allocate more staff at hospitals to deal with patients that have less serious injuries.

5. How ……. How you will do it. Explain your methodology (step by step process).

The steps of this method will go in this order:

1. **Decide components** for the **sensors** (ultrasonic or laser) and **computing module** (Arduino or Raspberry Pi microcontroller). It was agreed that ultrasonic and laser distance sensors were the most appropriate with the design of this project [6].
    a. If the proposal to use the **laser distance sensors** cannot be approved (source is Core Electronics), then the system will need to rely on ultrasonic distance sensors instead, or test with different types of sensors available locally.
    b. An optional add-on to the system could be adding a camera module to take pictures for every detection made by sensors. This is not high priority.
2. **Research Platforms** to **transmit data** to and a **UI** for users to **access data** from mobile devices e.g., Blynk.
3. **Code** a **program** for receiving the data from sensor and passing to the program that handles the logic/algorithmic part of the system.
4. **Plan and code** a **program** that handles the **logic** for the counting system, which can be an algorithm. The output should be a JSON/SQL file which can be used to generate an analytical report on the data stored in it.
5. **Code** a separate **program** that can be used to **test the sensors**.
    a. This can either be by testing the physical hardware itself or through simulations.
    b. If more than one sensor is provided, compare the accuracy and performance of each of them to determine which one may be more suitable for the project.
6. **Integrate** the **sensors program** with the **logic program**.
7. **Test** the integration of programs.
8. **Set up** the **UI** to display transmitted data to users of mobile devices on a Platform e.g., Blynk [7], or a Web application for PC users.
9. **Set up** the **database** on a **cloud service** so that the data can be stored there.
10. **Test** that the **data** is successfully being **transmitted to the UI**.

6. What will be the functionality of your software?

   The system should have the following functionalities:

   - Keep **count** of how many **people** are **currently occupying** the **location** the system is implemented at e.g., inside a public bus, inside a hospital. This should be capable of detecting people getting in and out (if someone is getting on, the count should be incremented, and decremented if they are getting off).
     - The system should be able to determine which direction people are moving instead of working one-way – the sensors should know if the people are getting in or out, and not if a person has simply passed through.
     - The data that will be transmitted should be sent to a database over the Internet/Cloud through Wireless LAN. This could be a few seconds after the last detection has been made before the collected data is transmitted to the system's Platform.
   - **Record** the number of **people walking in** the system's implemented location during a time period.
   - **Transmit** the **data** from the system's the computing module to the **database** over the Internet/Cloud for **users** to be able to **access** that **data** via some mobile app. The data should contain the bus's ID, the number of people currently at a location, number of people walking in during a particular time interval, and the time that the data was recorded.
     - The system should use Wireless LAN to connect to another router at that location that can act as a gateway between the system and the Internet.
   - **Set up** a **low time complexity algorithm** for **analysis** over the data collected and output some recommendation and analysis report as well.
   - The following functions are not required, but are possible add-ons to the system:
     - The data could contain **photos** taken the moment a detection is made by sensors to ensure that the **detections** made are **accurate** (you should see people passing in the photos).
     - Use a camera and AI software to detect whether people have passed through by taking photos as they pass through, count the number and even the sex or other

data with image processing methods. Collect the data and save it to database, compare and combine them with the base data using laser sensor and get more accurate output. This step would be using OpenCV or Mediapipe library to realize the function.

7. Hardware required (Each group has $50 budget for the items (not including costs of Raspberry Pi, Arduino, Breadboards, LCD and sensors available in Arudino kits). Due to existing circumstances, you should choose items from Jaycar and Altronics.

S. Nr	***Items Description***	***Cost***	***Web address***	***Delivery Time***
CE07741	PiicoDev Laser Distance Sensor VL53L1X **x 2** *(To be bought on **Core Electronics**)*	2 x $20.55 + $7.36 standard shipping = **$49.26**	https://core-electronics.com.au/piicodev-laser-distance-sensor-vl53l1x.html	15/09/2023
CE07690	PiicoDev Adapter for Raspberry Pi		https://core-electronics.com.au/piicodev-adapter-for-raspberry-pi.html	
CE07774	PiicoDev Cable 200mm **x 2**		https://core-electronics.com.au/piicodev-cable-200mm.html	
CE05436	RPI 3B+		https://core-electronics.com.au/raspberry-pi-3-model-b-plus.html	
CE00278	5VDC Power Supplies for RPI 2 and 3		https://core-electronics.com.au/raspberry-pi-3-power-supply.html	
CE00304	Solderless Breadboard - 830 Tie Point (ZY-102)		https://core-electronics.com.au/solderless-breadboard-830-tie-point-zy-102.html	
CE05112	HC-SR04 Ultrasonic Module Distance Measuring Sensor **x 2**		https://core-electronics.com.au/hc-sr04-ultrasonic-module-distance-measuring-sensor.html	
PRT-12795	Jumper Wire 20cm Ribbon (M/M, 40pcs)		https://core-electronics.com.au/jumper-	

			wires-connected-6-m-m-20-pack.html	
ADA826	Jumper Wire 20cm Ribbon (M/F, 40pcs)		https://core-electronics.com.au/premium-female-male-extension-jumper-wires-40-x-6-150mm.html	
PRT-14492	Resistors 1k Resistor 1K Ohm 1/4 Watt PTH - 20 pack (Thick Leads)		https://core-electronics.com.au/resistor-1k-ohm-1-4-watt-pth-20-pack-thick-leads.html	

8. An initial Distribution of Work among students by mutual discussion (You can change this distribution during the project, as per strengths of the members)

Name of Student	***Work Assigned***
Rongchuan Sun	Programming & testing sensors, integration testing
Brandon Ke	Project management, system testing
Aryan Radadiya	Database & User Interface
Yunwei Zhang	Programming computing module logic, integration testing

9. References (What research you have done while choosing this project).

[1] B. McGrath, “COVID-19 cases explode again in Japan, South Korea,” World Socialist Web Site, Jul. 30, 2022. Available: https://www.wsws.org/en/articles/2022/07/30/xvna-j30.html

[2] Peter Allely, “Hospital overcrowding could kill more people than COVID-19 in WA,” ABC News, Feb. 01, 2022. Available: https://www.abc.net.au/news/2022-02-02/hospital-overcrowding-could-kill-more-people-than-covid-19-in-wa/100792258

[3] J. W. Choi, X. Quan, and S. H. Cho, “Bi-Directional Passing People Counting System Based on IR-UWB Radar Sensors,” IEEE internet of things journal, vol. 5, no. 2, pp. 512–522, 2018, doi: 10.1109/JIOT.2017.2714181.

[4] I. G. Susrama Mas Diyasa, I. Yuniar Purbasari, A. Setiawan, and S. Winardi, “Smart Passenger Information System Based On IoT,” *2019 TRON Symposium (TRONSHOW)*, 2019, pp. 1–5. doi: 10.23919/TRONSHOW48796.2019.9166143.

[5] Nayana R and Bharathi Malakreddy A, “IoT Based Passenger Count System in Public Transport,” *International Journal of Innovations in Engineering and Technology (IJIET)*, vol. 10, pp. 93-96. Available: https://ijiet.com/wp-content/uploads/2018/06/14.pdf

[6] DroneBot Workshop, “Laser vs Ultrasonic - TOF10120 vs. HC-SR04,” YouTube, Nov. 25, 2019 [Video file]. Available: Laser vs Ultrasonic - TOF10120 vs. HC-SR04. [Accessed: Aug. 23, 2023]

[7] “Blynk,” Blynk.io, 2015. url: https://blynk.io/