EP0401 – Python Programming for IoT
Mini Project Specification

- This documentation outlines what you need to do for the **60%** mini project.

- In case of doubt, clarify with your lecturer.

Basic Requirements – the project team

Project is to be done **in pair.**

In a class with an odd number of students, one group with 3 students is allowed.

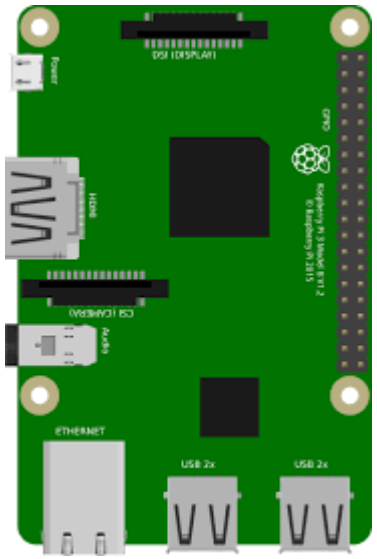
The lecturer may allow a more substantial project to be done by 2 sub-groups, each of 2 students.

In general, students are allowed to choose their teammates.

Basic Requirements – language & hardware

The project must use **Python** as the key programming language...

…and **Raspberry Pi** as the single board computer, since these are taught in the module.



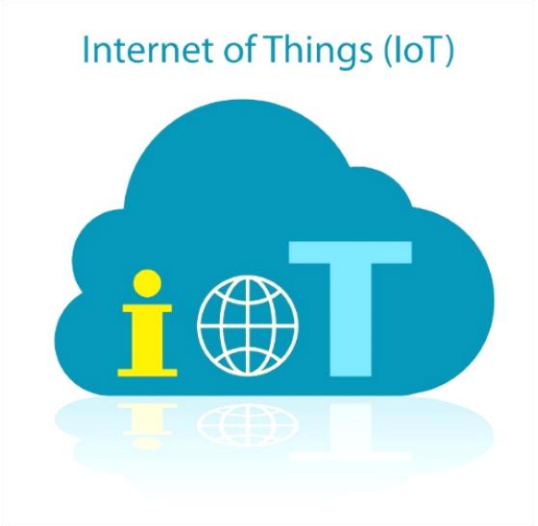
However, depending on the nature of the project, other secondary programming languages & microcontroller / microprocessor boards can be added.

Basic Requirements – application

The project must be an **IoT application**, which according to Wikipedia, is the following:

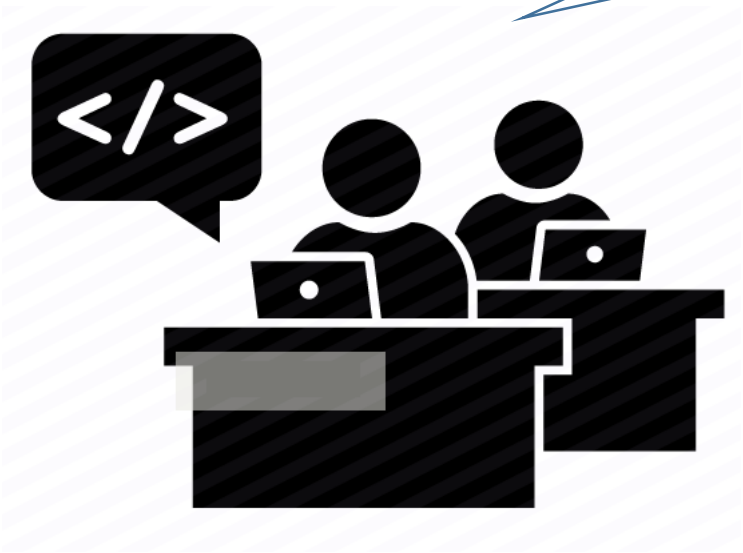
The Internet of things (IoT) is the network of devices, vehicles, and home appliances that contain electronics, software, actuators and connectivity which allows these things to connect, interact and exchange data.

IoT involves extending Internet connectivity beyond standard devices, such as desktops, laptops, smartphones and tablets, to any range of traditionally dumb or non-internet-enabled physical devices and everyday objects. Embedded with technology, these devices can communicate and interact over the Internet, and they can be remotely monitored and controlled.



Basic Requirements – effort

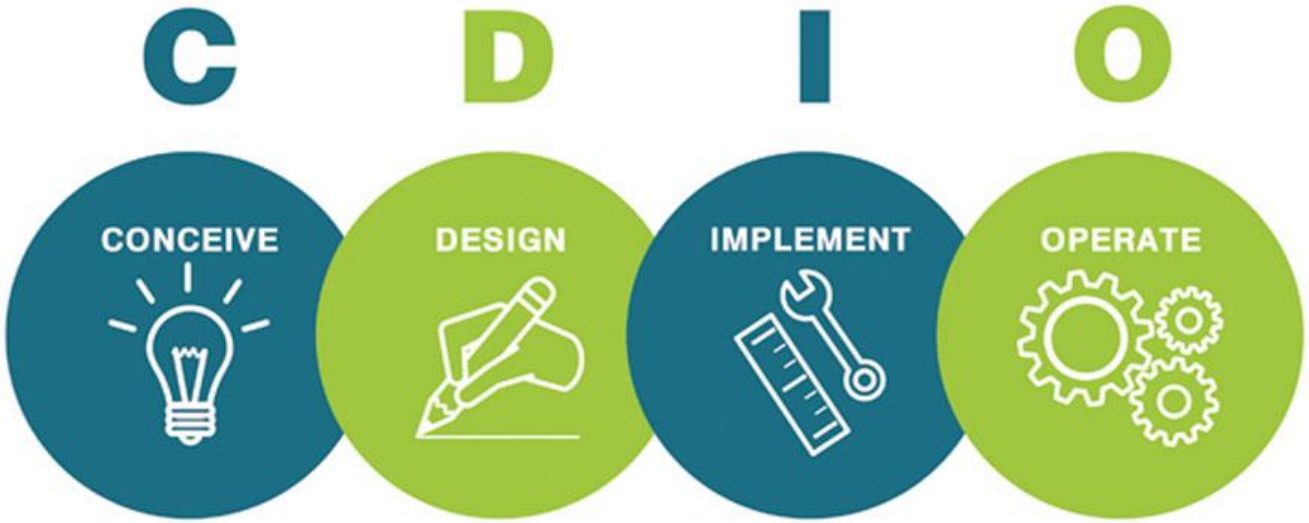
The official allocated hours is **28 hours**, including briefing, **presenting idea** for critique (**20%**), and **project show & tell** (**40%**) but you may spend more than this number of hours.



Most of the work is to be done during the practical lessons.

CDIO & Design Thinking

The methodology recommended is the **C-D-I-O** approach.



During the Conceive & Design stages, **Design Thinking** should be used.

CDIO & Design Thinking – in practice…

1. Select a **target user** group.

2. Understand their need, by **observation** or by **interview**.

3. With the **insights** gained, develop a **persona** i.e. a description of the typical target user.

4. **Brainstorm** several ideas (e.g. 2 persons -> 4 ideas) that can help the target users.

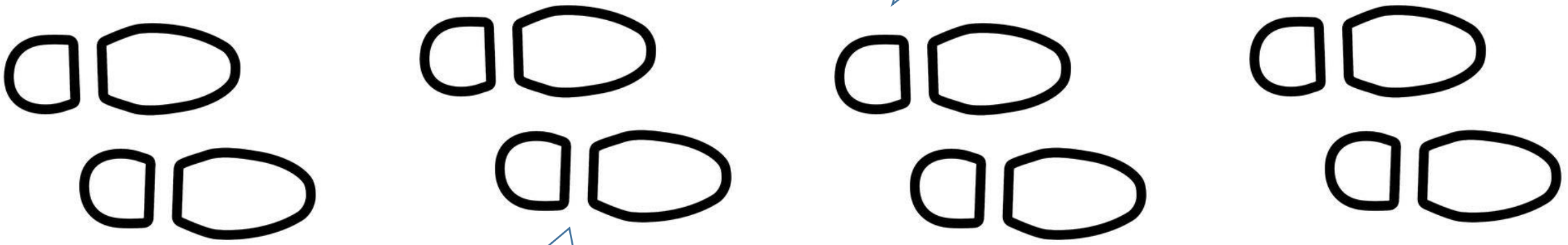
5. Use a 2x2 matrix (with axes labelled as **feasibility** & **impact**), select an idea for implementation.

6. Draw a **block diagram** to show how the hardware parts are to be connected.

7. Draw a **data flow** diagram to show how information will flow.

8. Draw a **flowchart** to show the main steps in the program.

9. Draw a **Gantt chart** to ensure that your project can be finished in time.



Presenting your idea (20%)

Has the team done good **research & analysis** to understand user needs? (25 marks)

Has the team shown that the project is **feasible** with the block diagram, flowchart, data flow diagram & Gantt chart? (25 marks)

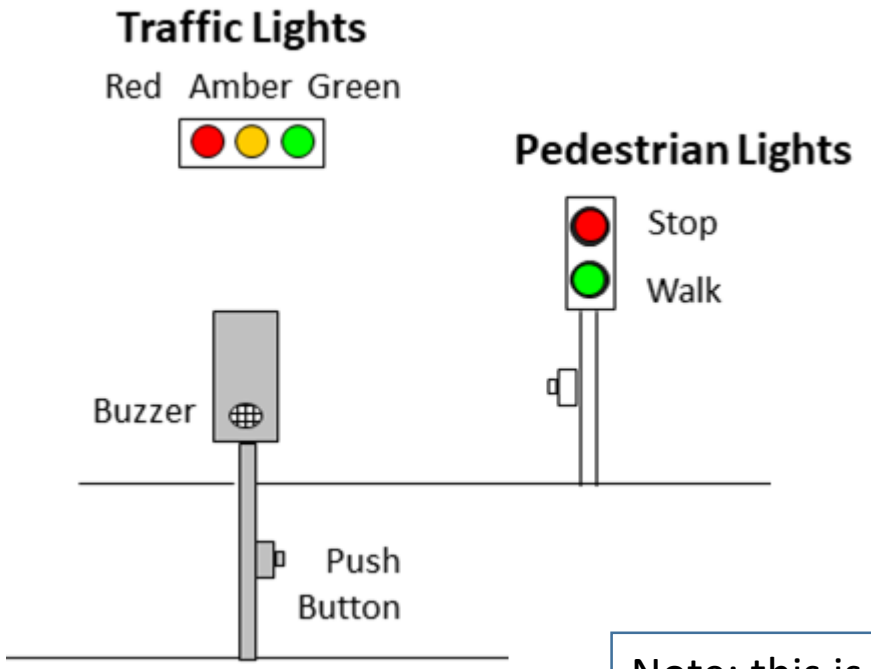
Has the team come up with a **creative idea** / solution to the user's problem? (25 marks)

Is the **presentation** lively & engaging? (25 marks)

Although common team marks can be awarded, individual students may score higher / lower marks, depending on his / her contribution.

Case study (read yourself)

Step 1: Select a **target user** group:
drivers driving pass a pedestrian crossing.



Note: this is a brief demo of the steps required to prepare for the idea presentation.

Step 2: Understand their need, by **observation** or by **interview**:

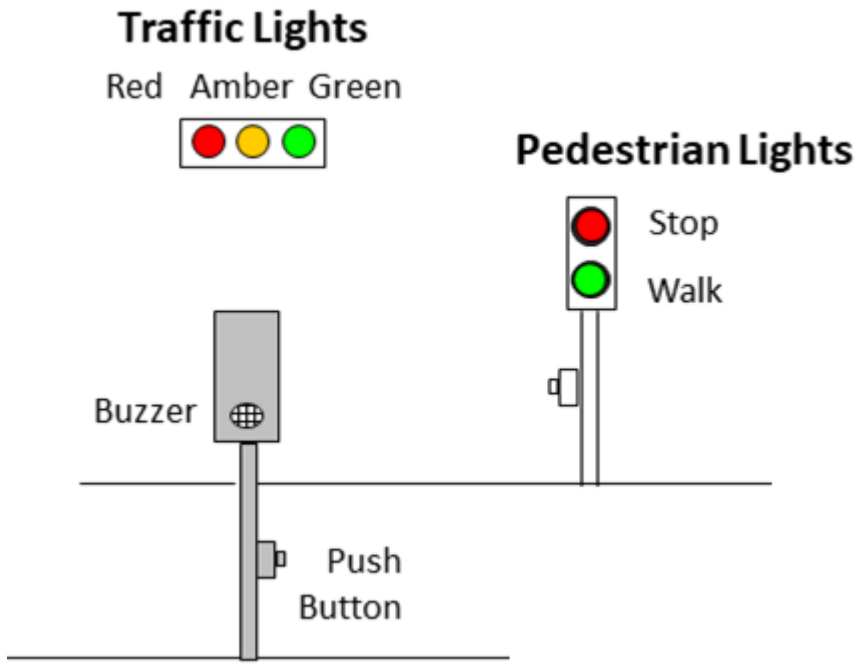
Observations:

1. The traffic & pedestrian lights use fixed timing: 10 sec for traffic, 3 sec to stop, 10 sec for pedestrians. The button seems to have no effect on how the lights change.
2. Drivers have to stop at the pedestrian crossing, even though no one is crossing the road.

Interview:

1. A few drivers suggest that when there is no one crossing the road i.e. the button has not been pressed, the traffic lights should remain green for traffic to continue moving. When the traffic lights have changed green, the traffic should be given at least 10 seconds to move, even if someone presses the button.

Case study (cont.)



Step 3: With the **insights** gained, develop a **persona** i.e. a description of the typical target user:

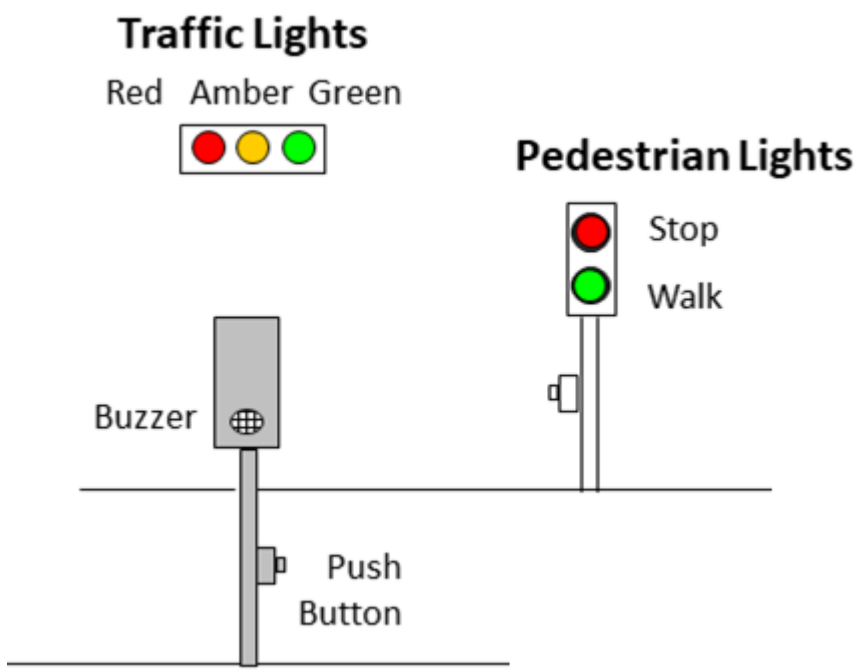
Miss Tan is a young professional who drives to work every day. She has to drive pass the pedestrian crossing every day at 8 in the morning and at 9 in the evening.

She has noticed that the pedestrian lights will turn green (i.e. Walk) even when there is no one waiting to cross the road. It is very frustrating especially when she is rushing home after a day of hard work in the office.

She has commented that the traffic lights should remain green if no one presses the button. If someone is waiting to cross the road, the traffic should be given at least a certain amount of time, say 10 seconds, to move. This will be fair to both drivers and pedestrians.

She looks forwards to a “traffic & pedestrian lights” system that makes sense to both groups of users..

Case study (cont.)



Step 4: **Brainstorm** several ideas (e.g. 2 persons -> 4 ideas) that can help the target users:

Idea 1: Change the **algo**rithm or traffic & pedestrian lights behaviour to the following:

- 10 sec (min) for traffic to move, 3 sec for traffic to stop, 10 sec for pedestrian to cross.
- If no one is crossing the road, traffic lights will remain green.
- If the button is pressed when traffic light is green, give at least 10 sec for traffic to move, before changing to amber.

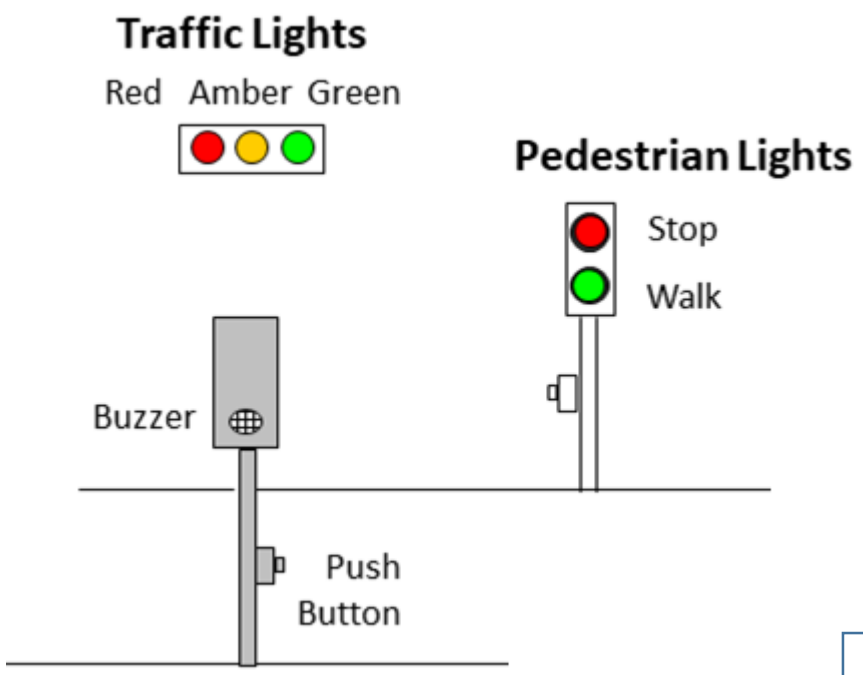
Idea 2: Building an **overhead bridge / underpass**, so that traffic and pedestrian will not be competing with each other for the use of the road.

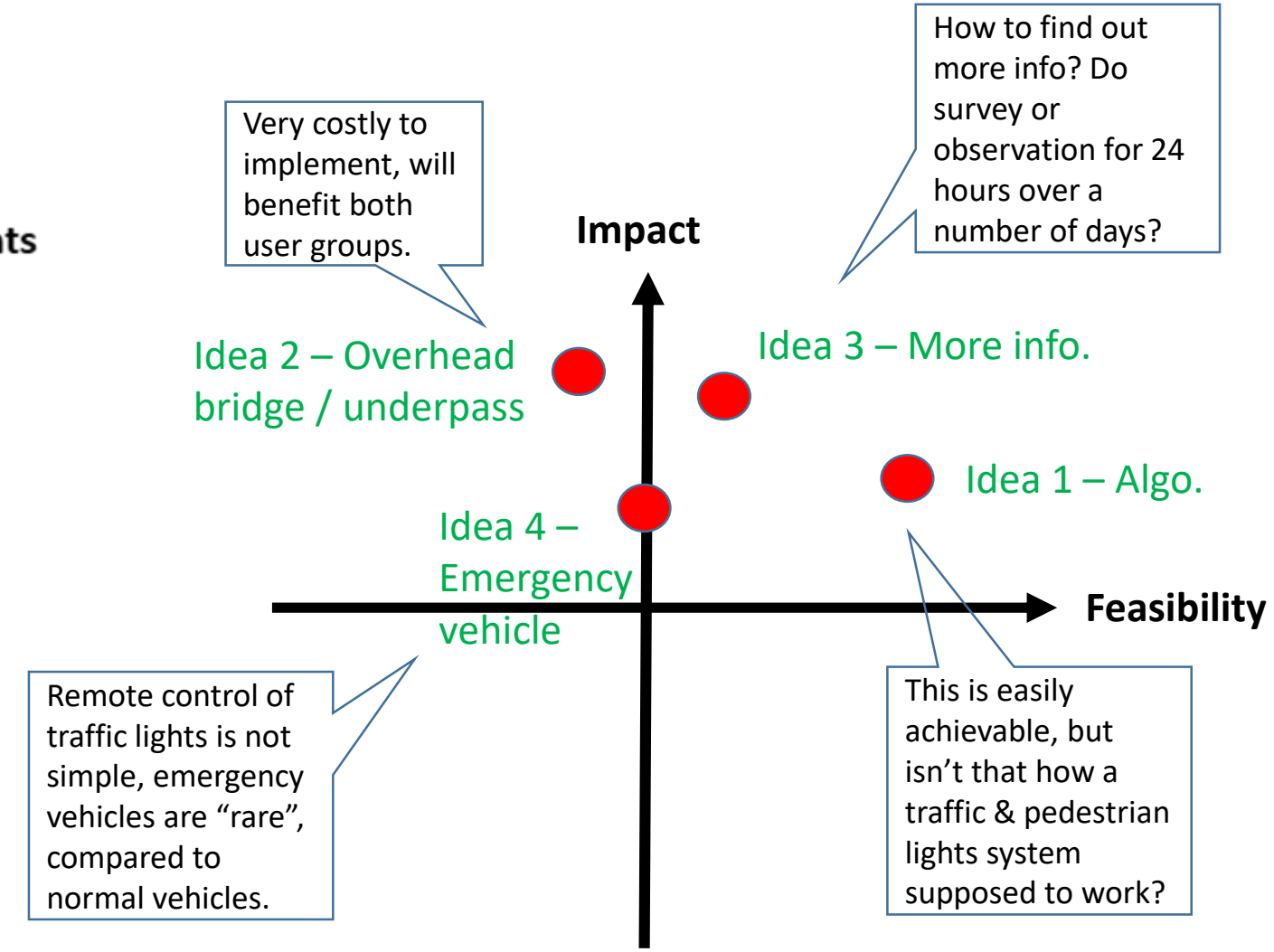
Idea 3: Collect **more info**rmation on the crossing, so that more informed decision can be made.

Idea 4: Consider the needs of **emergency vehicles** such as ambulance, police car, fire engine that really need the traffic lights to be green, even when pedestrians are waiting to cross the road. Can we have “green wave traffic lights” where a series of traffic lights in the direction of the emergency vehicle will turn green one after another, allowing it to move rapidly?

Case study (cont.)

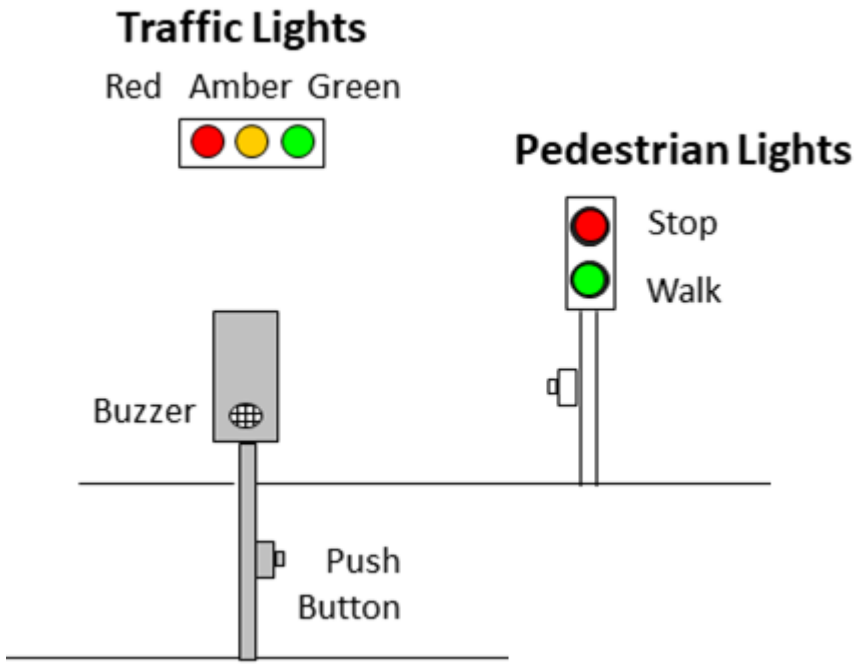
Step 5: Use a 2x2 matrix (with axes labelled as **feasibility** & **impact**), select an idea for implementation:



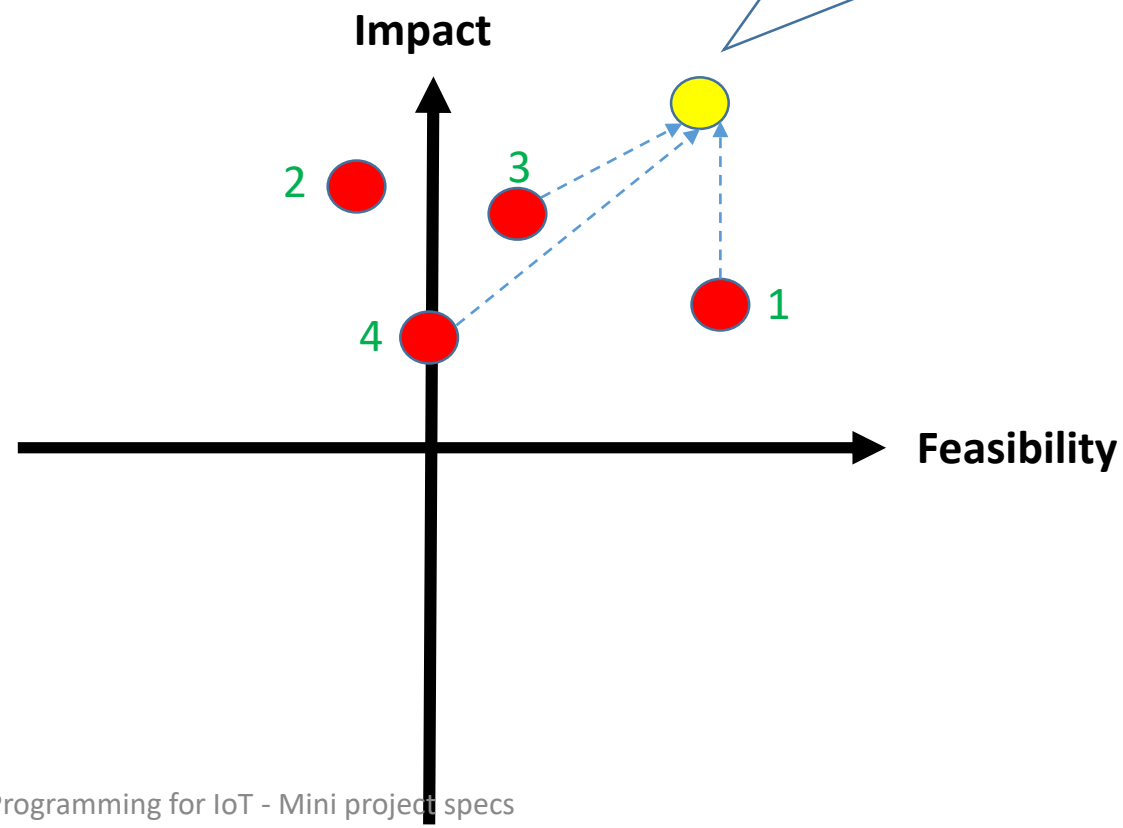


Case study (cont.)

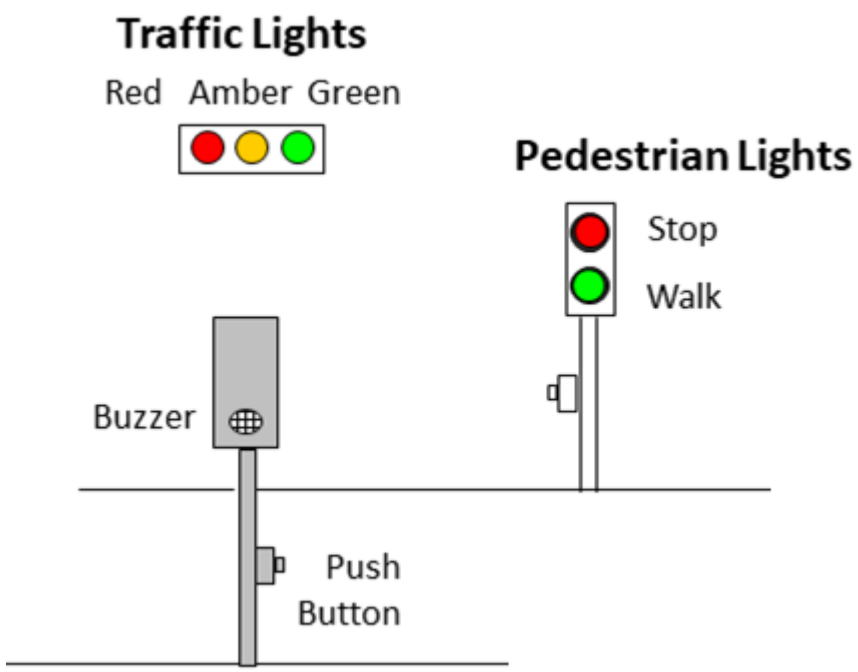
Step 5 (cont.)



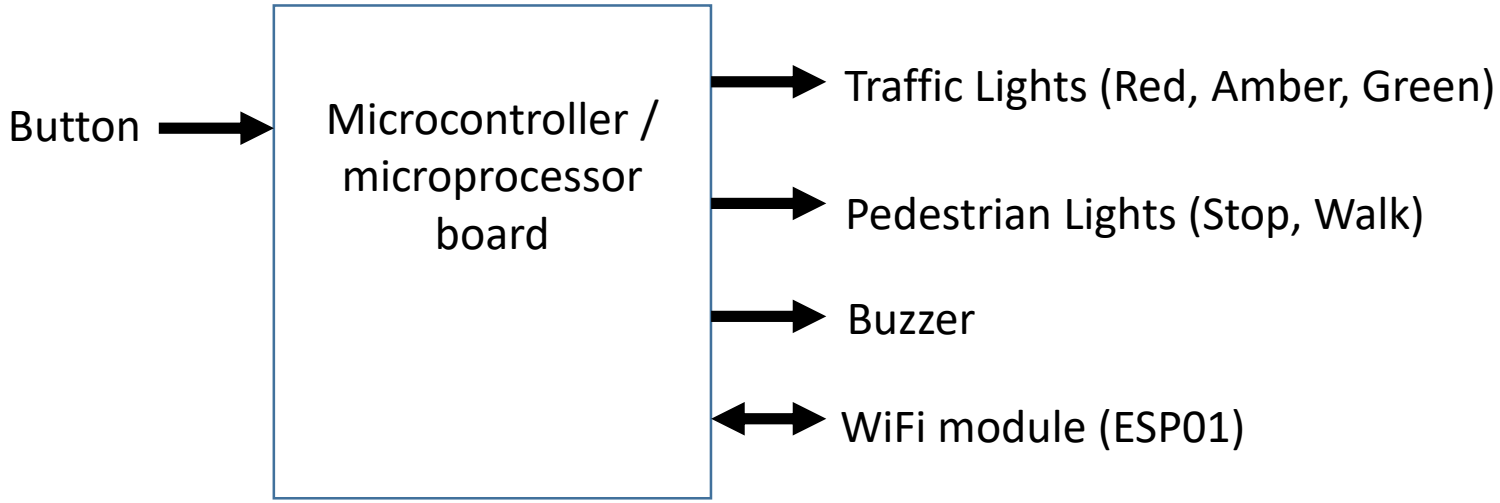
Our proposal is to combine ideas 1, 3 & 4, by changing the algorithm (how traffic & pedestrian lights change), and adding a WiFi module to collect more info on the pedestrian crossing, at the same time allowing the lights to be remotely controlled, for an emergency vehicle. This results in a lot more impact.



Case study (cont.)

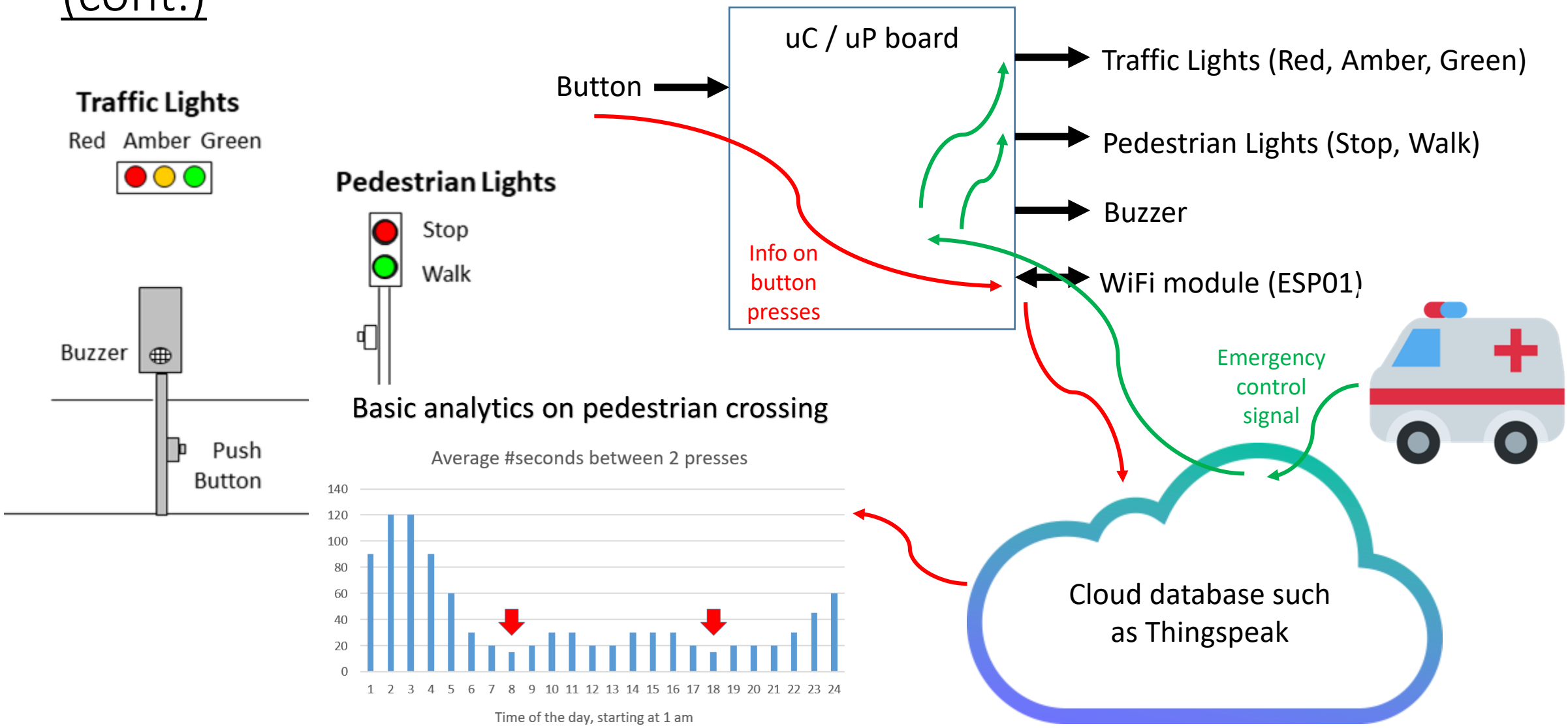


Step 6: Draw a **block diagram** to show how the hardware parts are to be connected:

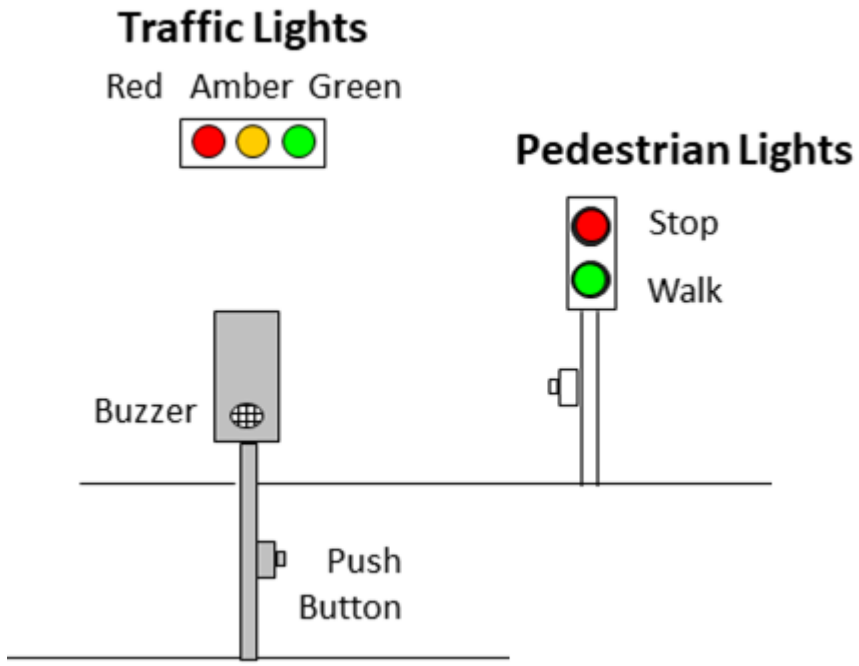


Case study (cont.)

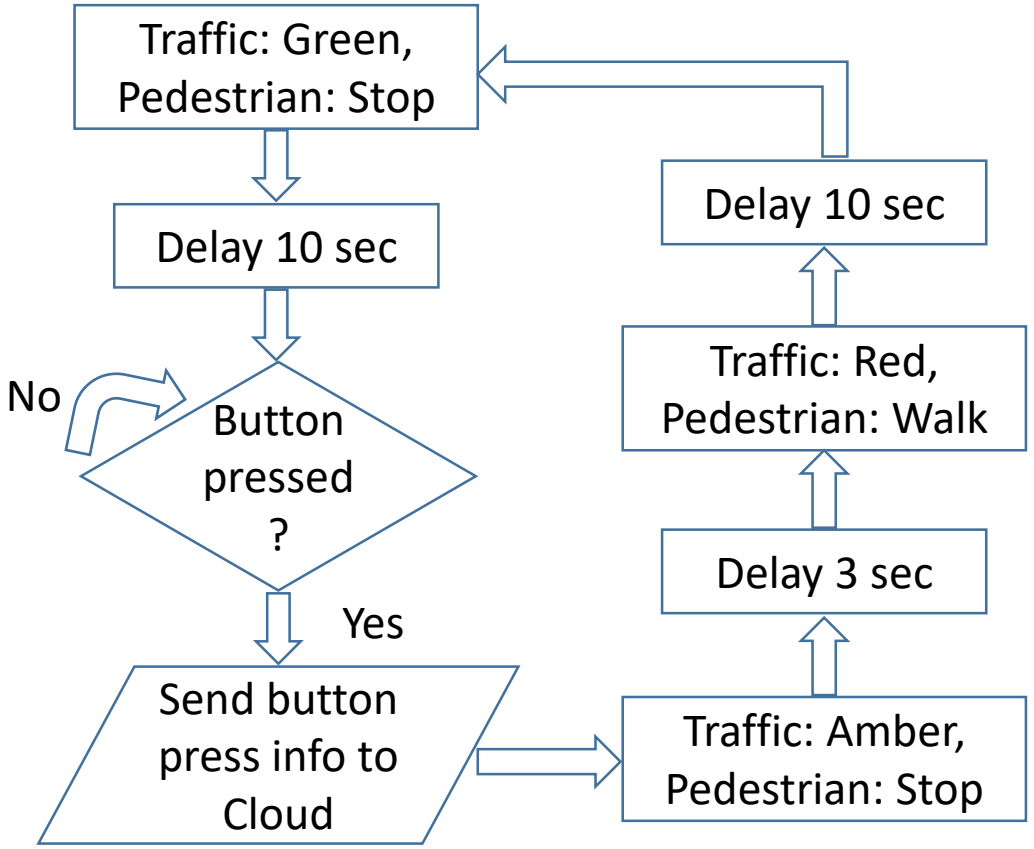
Step 7: Draw a **data flow** diagram to show how information will flow:



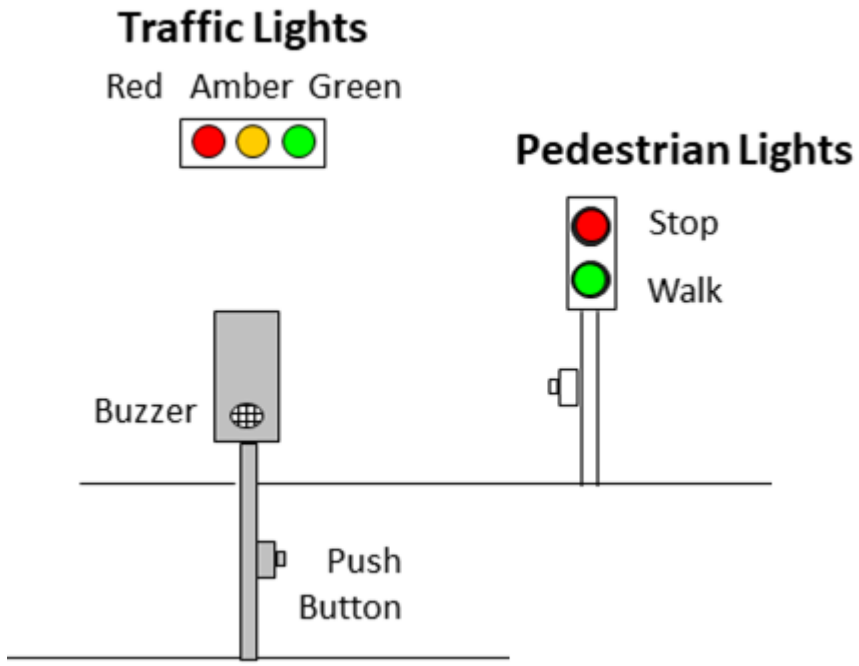
Case study (cont.)



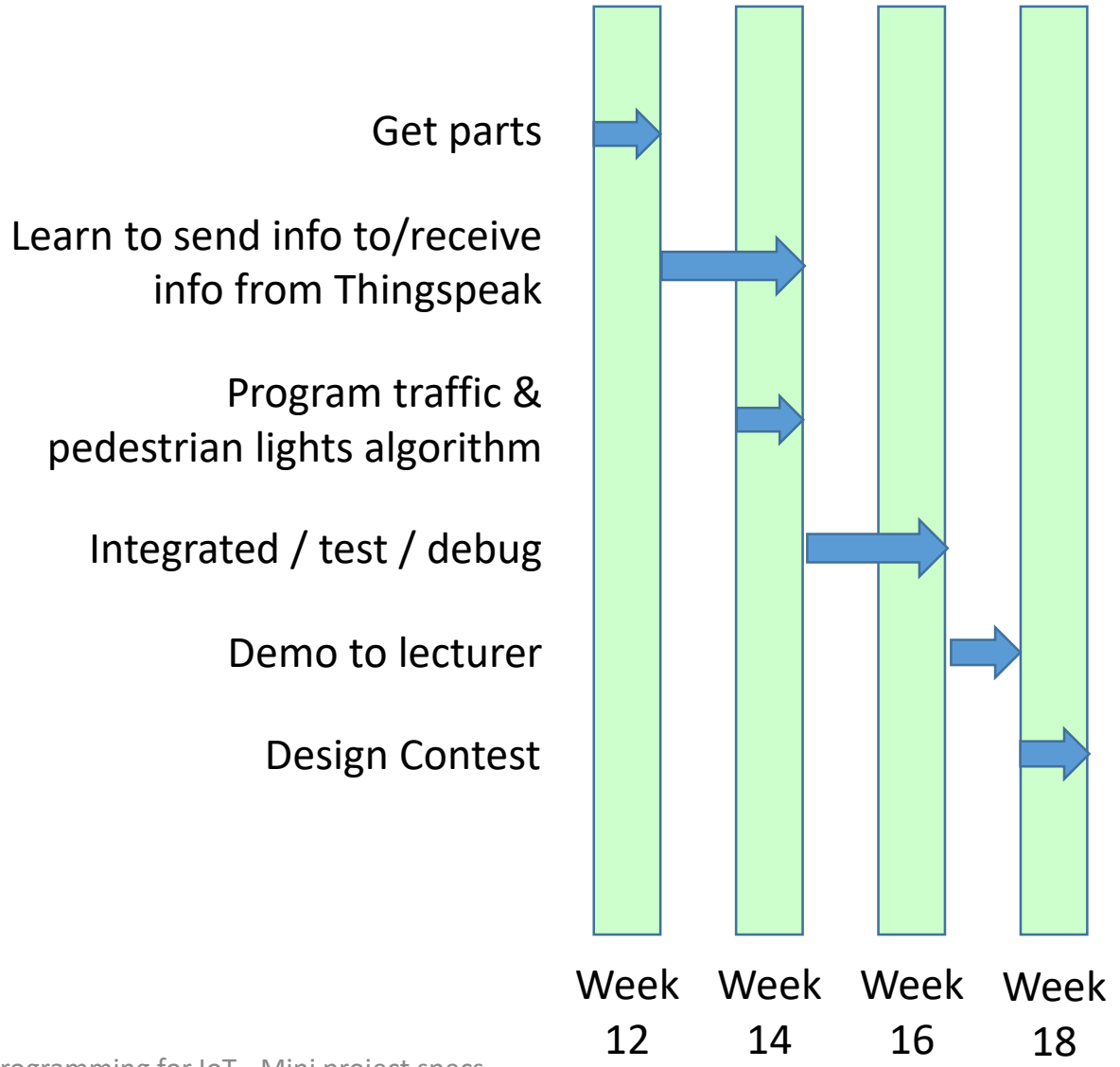
Step 8: Draw a **flowchart** to show the main steps in the program:



Case study (cont.)



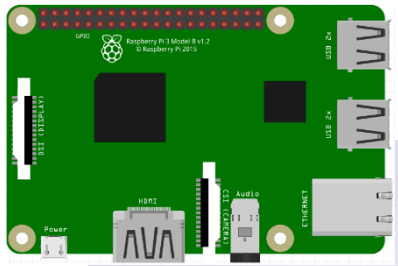
Step 9: Draw a **Gantt chart** to ensure that your project can be finished in time:

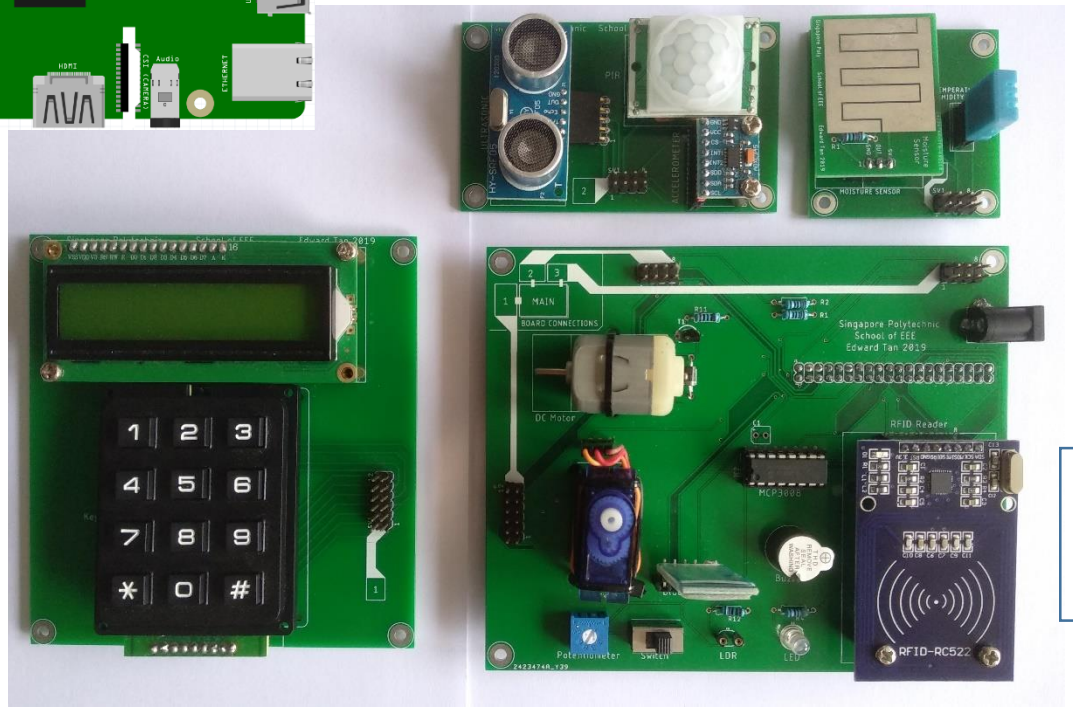


Resources for implementing your project

There is no budget for claim. So either use the parts made available, or foot the bills yourselves.

The PCB's (Printer Circuit Boards) used in the lab experiments can be used for the project.





You are encouraged to create a **GUI / dashboard**.

Project can also be implemented on stripboards, breadboards & jumper wires, your own parts, modules & shields.

You can also make use of the facilities in **Fab Lab**.

Project show & tell (40%)

At the end of the semester, each team will be given **10-15 minutes** to show & tell the project.

Is the project working i.e. a **success**? (25 marks)

Did the team put in **effort** in implementation? (25 marks)

General: Has the team shown good team work, initiative, resourcefulness, perseverance, ingenuity, good time management skills and critical thinking skills? (25 marks)

Is the **show & tell** lively & engaging? Can students answer questions asked? (25 marks)

Again, although common team marks can be awarded, individual students may score higher / lower marks, depending on his / her contribution.

The very good projects will be entered into a mini-competition with prizes, certs & bonus marks.

Feel free to clarify any doubt you may have regarding this assessment, with your lecturer.