

OPTIFLOW

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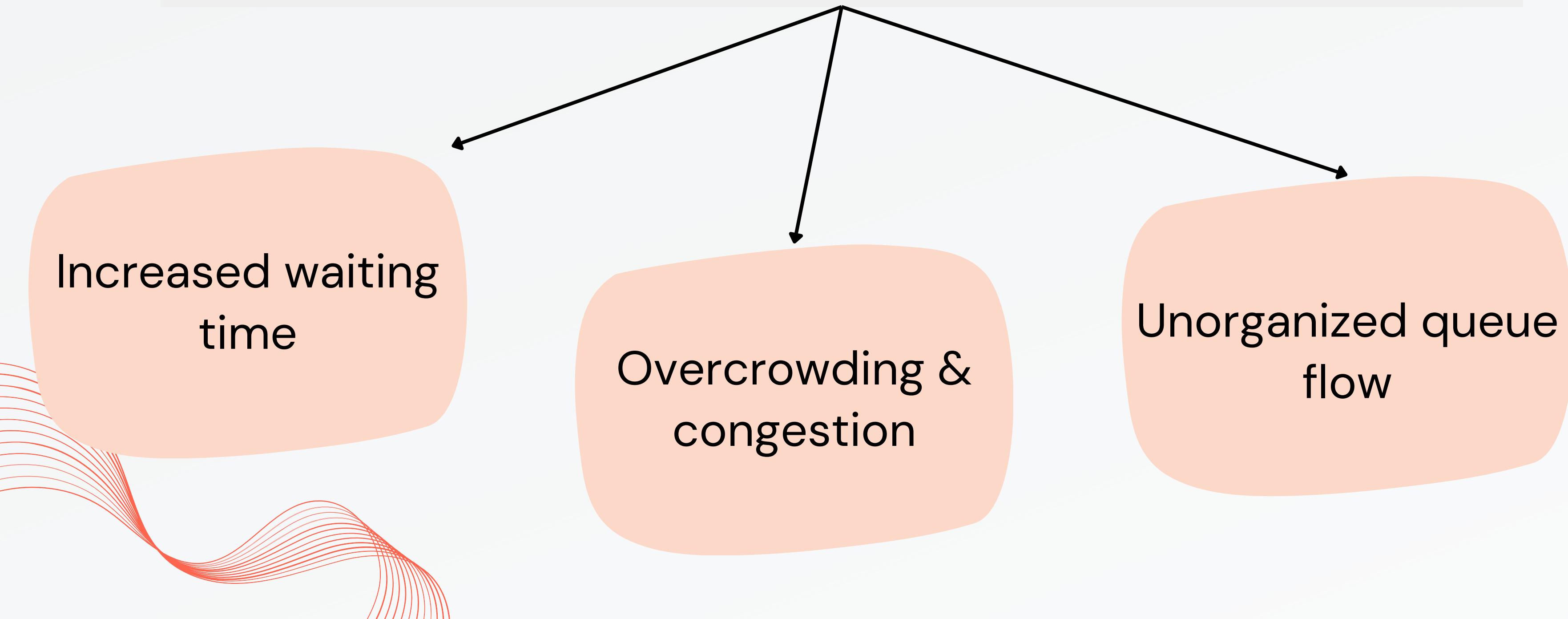
Mattias



BACKGROUND

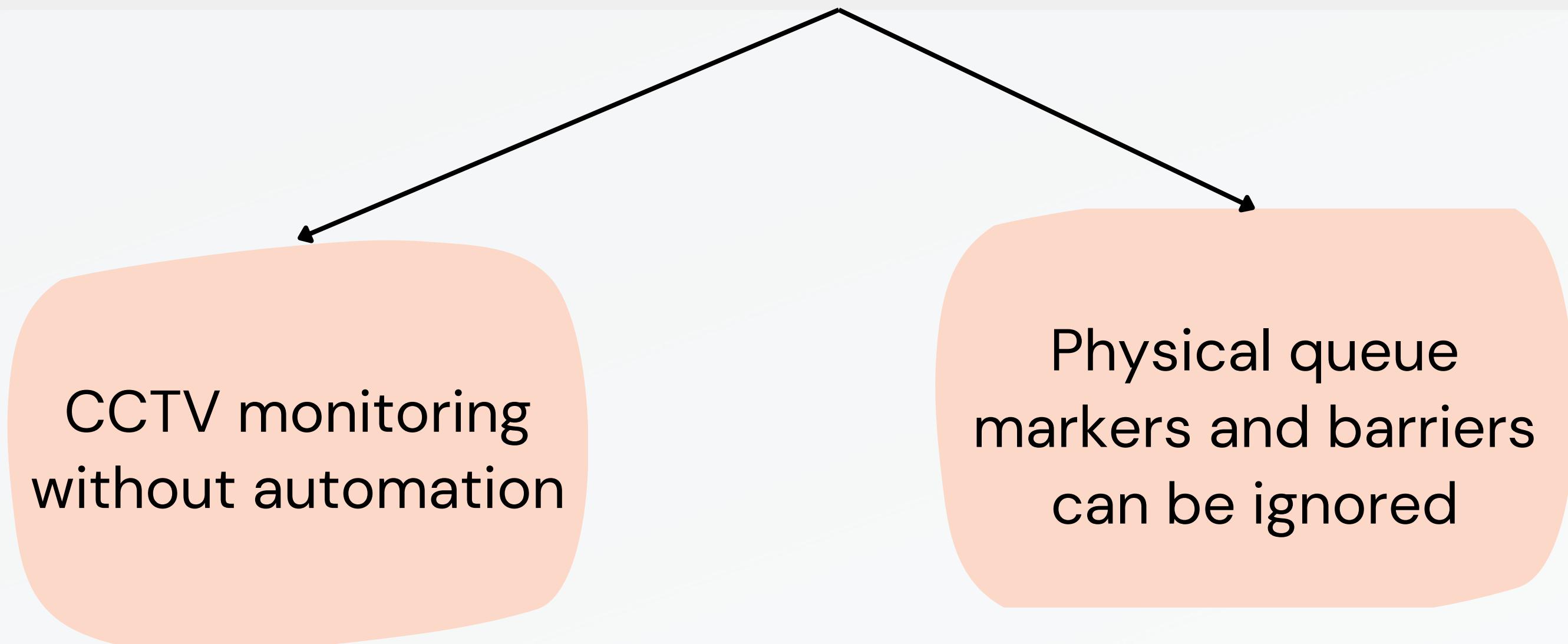
ISSUE

Long queues are a common issue in high-traffic areas.



ISSUE

Issues with Traditional methods of crowd control



PAST EVENT

Thaipusam Festival Delays (2025):

- Huge crowd led to confusion over queues for participants
- People left queueing up to three hours.
- Caused people to lose their composure



OBJECTIVES

Develop an IOT based crowd control system to detect crowd density and prevent overcrowding

Gary

LITERATURE REVIEW

CROWD SIZE ESTIMATION USING OPENCV AND RASPBERRY PI

SOFTWARE & LIBRARIES:

- Python 3.0
- OpenCV 3.0
- Imutils
- Matplotlib
- ThingSpeak

THOUGHTS:

We can try using OpenCV Library for our Pi camera and then implement YOLO V8 model for people count.

We can also use ThingSpeak for our real time **Dashboard** for data.

NOTE: The project uses a Raspberry Pi and OpenCV to estimate crowd size via image processing, then uploads real-time data to ThingSpeak for cloud visualization, enabling remote monitoring of crowd density.

EXPERT EXPLAINS THE HIDDEN CROWD ENGINEERING BEHIND EVENT VENUES

WSJ PRO PERFECTED

Key Ideas:

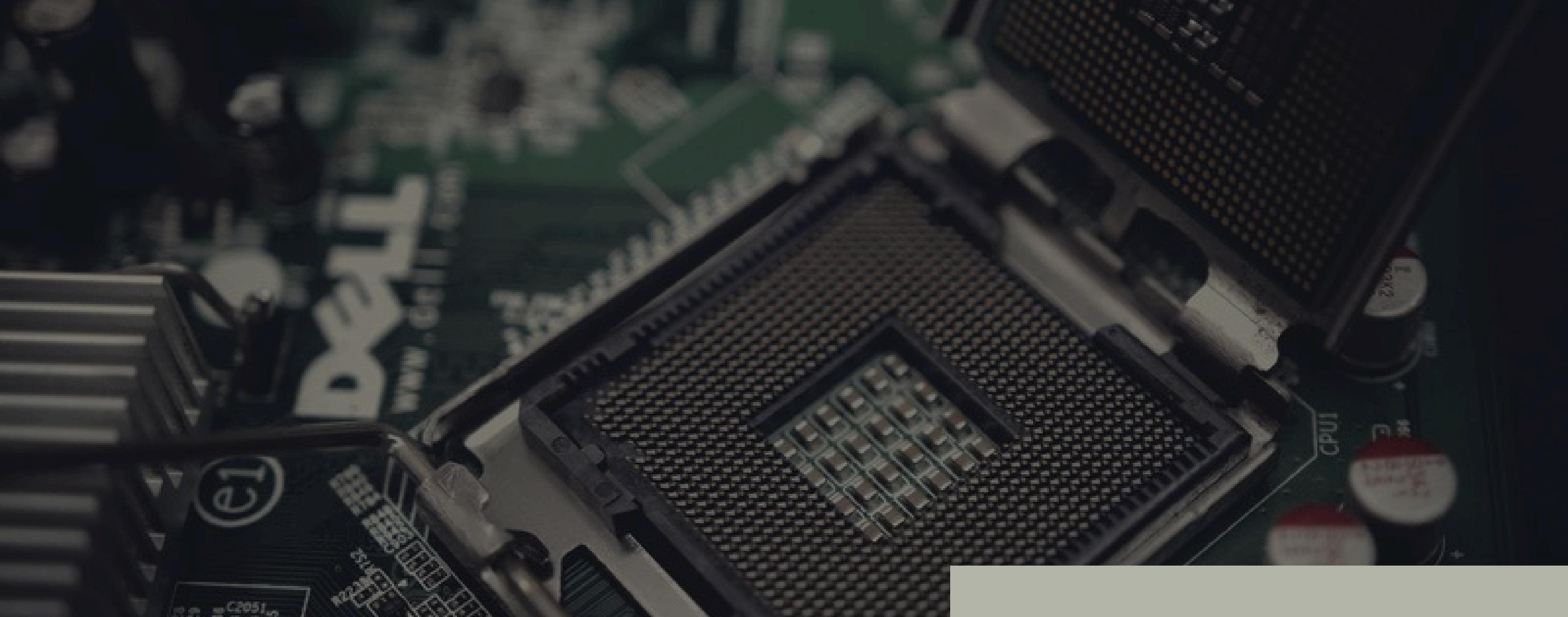
- Engineer queues
- Worse case of overcrowding is **fatalities**
- Slow arrivals to more evenly spread out arrivals in a period of time.
- Keep people moving in queues
- Shape: Multiple lanes can ensure equality but indecision at the start when picking a shorter queue.

Cons:

- Unable to slow arrivals as it is out of our domain.
- Can't move people constantly directly.
- Can't modify the shape much as it may be out of our domain.

Pros:

- We can engineer the queues.
- The dangers of overcrowding supports our project's real world applications.
- We can keep moving people indirectly through faster queue systems.
- We can adapt the **multiple lanes shape** to our project.



HARDWARE

COMPONENTS

Motors

- Opening/Closing the gate



Liquid Crystal Display (LCD)

- Provides information about the queue capacity.



Raspberry Pi 4B 4GB RAM

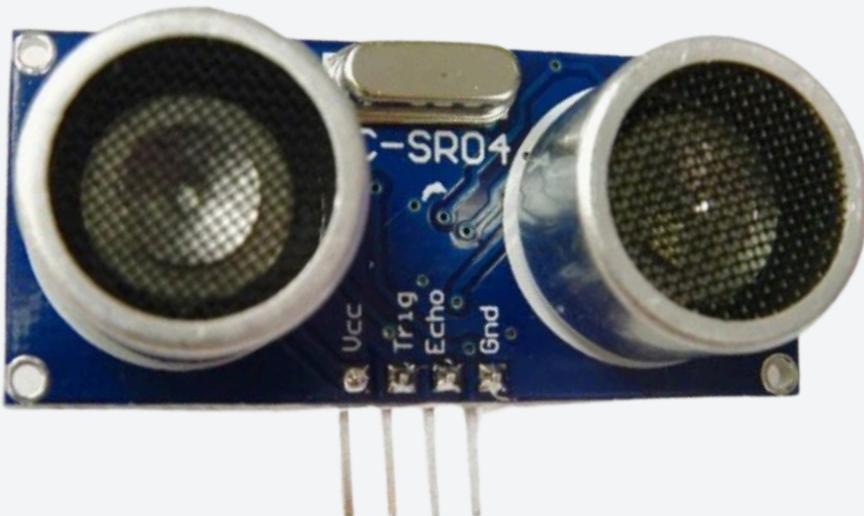
- Micro-controller. Main system frame that links all parts together.



COMPONENTS

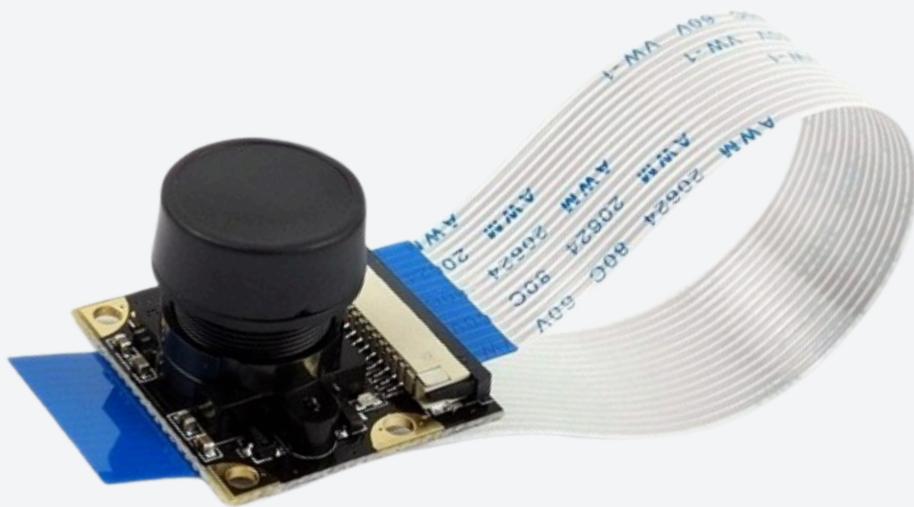
Ultrasonic Sensors

- Detect motion of the queue and attendees moving in and out.



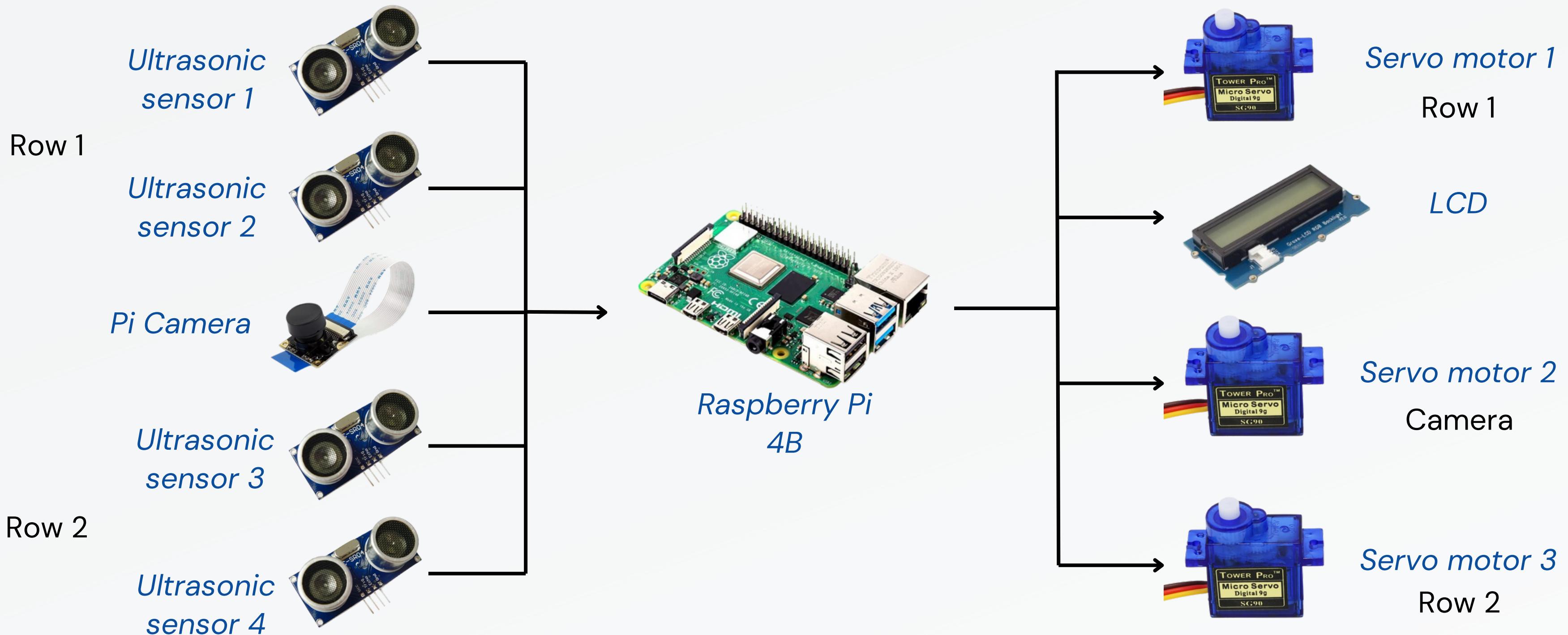
Raspberry Pi infrared Camera

- Crowd density count via Computer Vision. Yolo V8 applied.



BLOCK DIAGRAM

Inputs

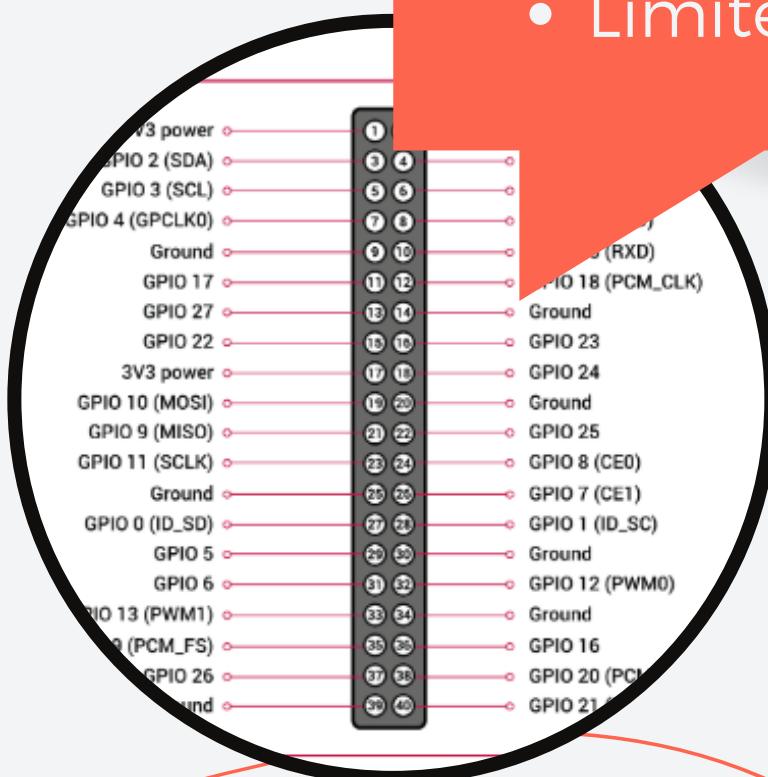


Outputs

HARDWARE LIMITATIONS

Limited Resources

- Limited to a few sensors and output modules.
- Limited to 1 camera.



Faulty parts

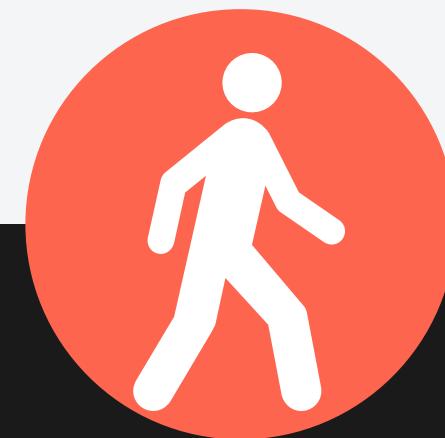
- Wasted a lot of time debugging only to realise its because of faulty parts.
- Caused confusion when wiring and testing.





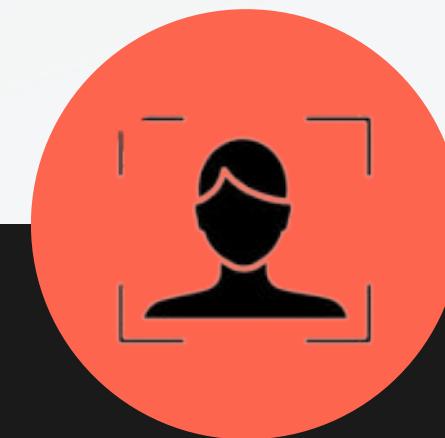
SOLUTION APPROACH

OUR SOLUTION



Motion
Detection

STEP 1



Object
Detection

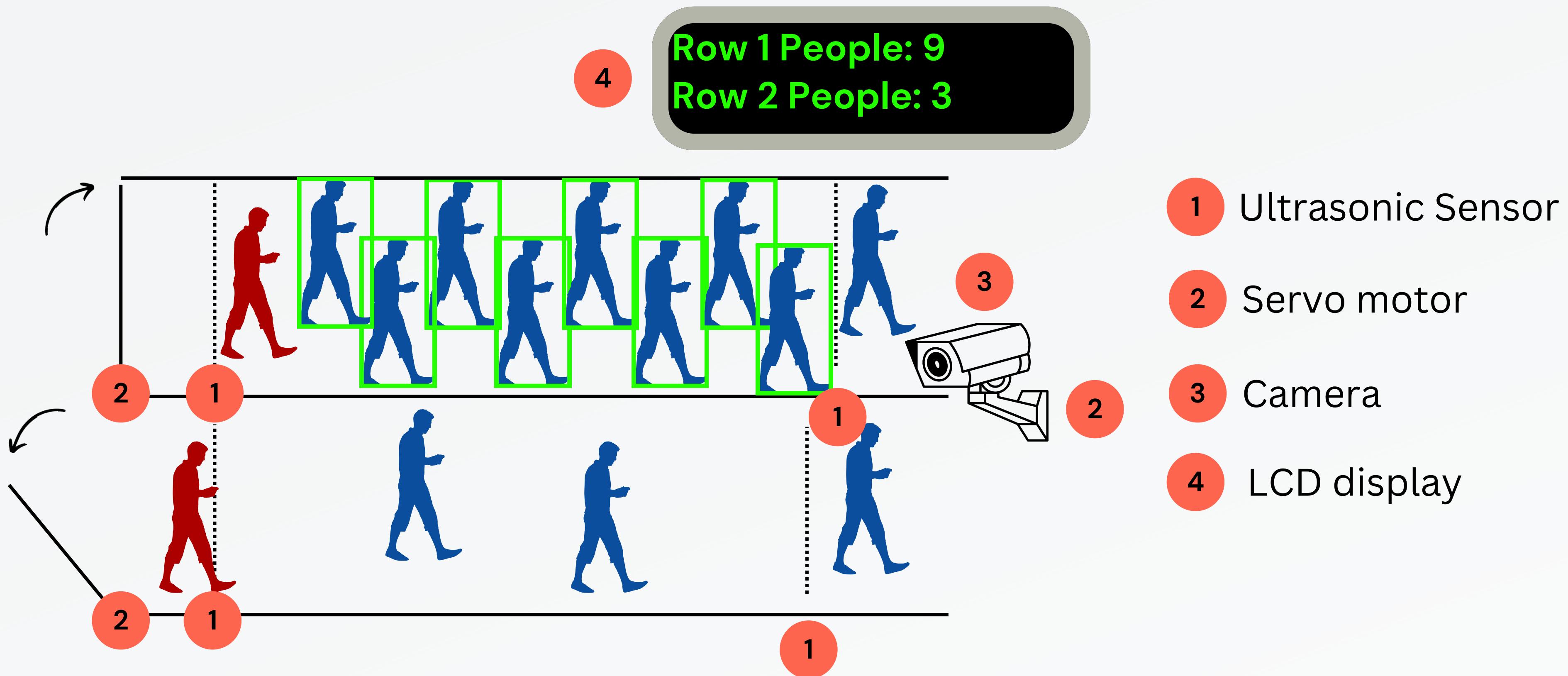
STEP 2



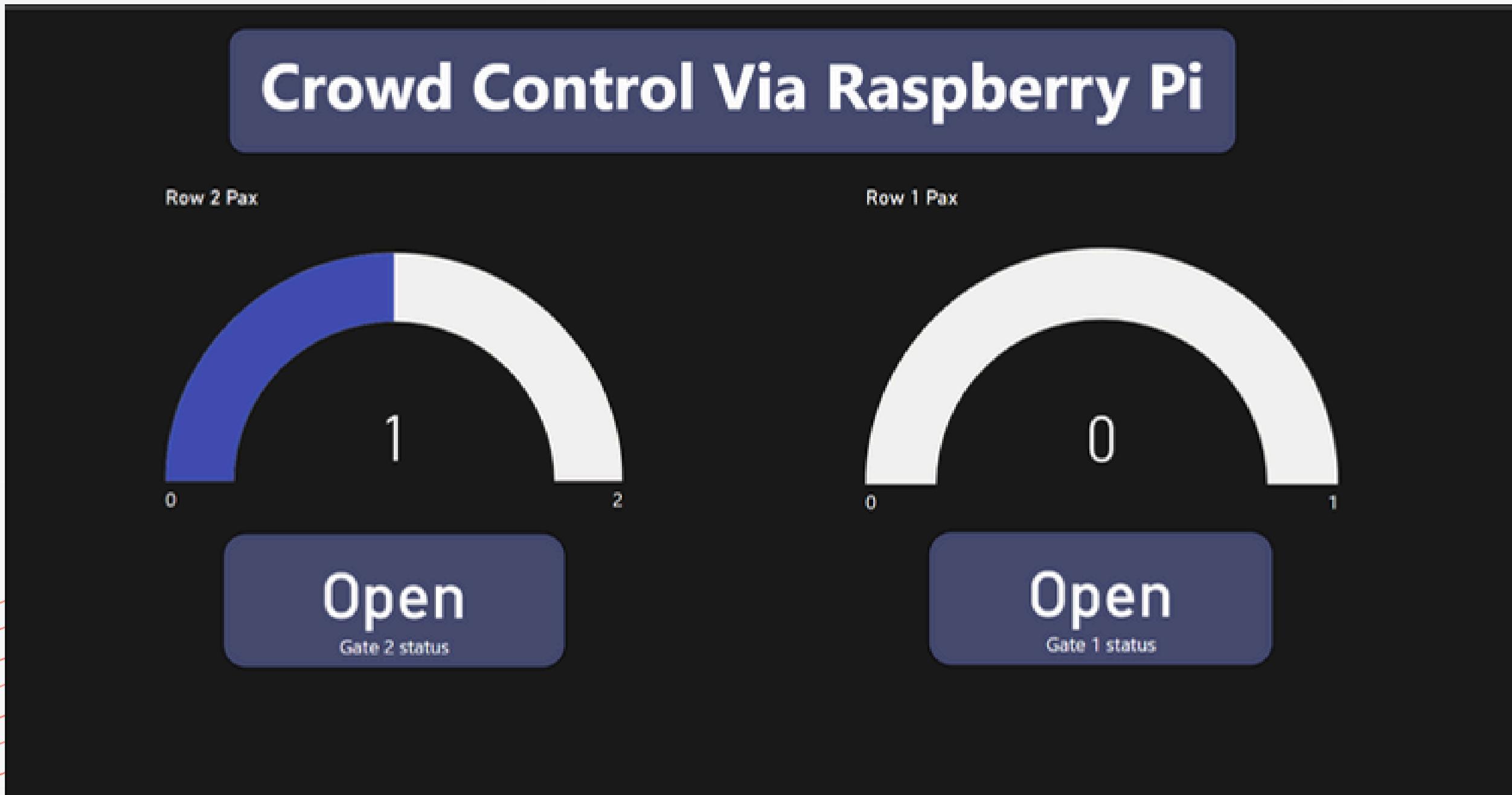
Crowd
Management

STEP 3

HOW DOES IT WORK



DATA VISUALISATION & LOGGING



```
logs.csv > data
 1  row1_count, row2_count, yolo_count, Gate1, Gate2, timestamp
916 1, 7, 7, Open, Close, 2025-02-19 11:22:08
917 1, 7, 7, Open, Close, 2025-02-19 11:22:14
918 1, 7, 7, Open, Close, 2025-02-19 11:22:19
919 1, 7, 7, Open, Close, 2025-02-19 11:22:24
920 1, 7, 7, Open, Close, 2025-02-19 11:22:30
921 1, 7, 7, Open, Close, 2025-02-19 11:22:35
922 1, 7, 7, Open, Close, 2025-02-19 11:22:40
923 1, 7, 7, Open, Close, 2025-02-19 11:22:45
924 1, 7, 7, Open, Close, 2025-02-19 11:22:51
925 1, 7, 7, Open, Close, 2025-02-19 11:22:56
926 1, 7, 7, Open, Close, 2025-02-19 11:23:01
927 1, 7, 7, Open, Close, 2025-02-19 11:23:07
928 1, 7, 7, Open, Close, 2025-02-19 11:23:12
929 1, 7, 7, Open, Close, 2025-02-19 11:23:17
930 1, 7, 7, Open, Close, 2025-02-19 11:23:23
931 1, 7, 7, Open, Close, 2025-02-19 11:23:28
932 1, 7, 7, Open, Close, 2025-02-19 11:23:33
933 1, 7, 7, Open, Close, 2025-02-19 11:23:38
934 1, 7, 7, Open, Close, 2025-02-19 11:23:44
935 1, 7, 7, Open, Close, 2025-02-19 11:23:49
936 1, 7, 7, Open, Close, 2025-02-19 11:23:54
937 1, 7, 7, Open, Close, 2025-02-19 11:24:00
938 1, 7, 7, Open, Close, 2025-02-19 11:24:05
939 1, 7, 7, Open, Close, 2025-02-19 11:24:10
940 1, 7, 7, Open, Close, 2025-02-19 11:24:16
941 1, 7, 7, Open, Close, 2025-02-19 11:24:21
942 1, 7, 7, Open, Close, 2025-02-19 11:24:26
943 1, 7, 7, Open, Close, 2025-02-19 11:24:32
944 1, 7, Open, Close, 2025-02-19 11:24:37
```

BENEFITS



Enhanced User Experience



Proactive Risk Prevention



Efficient Crowd Control

FUTURE IMPROVEMENTS

Real-time
Camera-Based
Queue
Monitoring

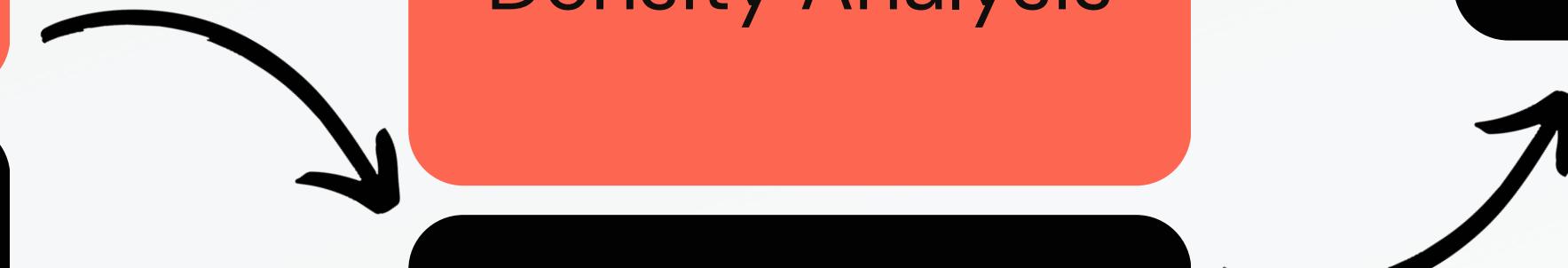
IMPROVEMENT 1

Thermal Imaging
for Crowd
Density Analysis

IMPROVEMENT 2

Anomaly
Detection for
Security Risks

IMPROVEMENT 3



1. Smart Wearable Bands for Seamless Crowd Flow

- Each participant wears a smart RFID/ NFC enabled wristband
- Participants tap their wristbands at checkpoints
- Vibration alerts

2. AI-Powered Smart Queue Optimization

- analyzes historical queue data, weather conditions and time of day
- AI dynamically reassigns people to different queues based on real-time

CONCLUSION

Detect crowd density



Ultrasonic sensor and
Pi camera

Prevent Overcrowding



Servo motor to
simulate gate locking

THANK YOU!

*Join us in shaping a world where
long waits are a thing of the past!*



CONTRIBUTIONS

Jin Bin	Mattias	Gary	Edric
<ul style="list-style-type: none">1. Code2. Slides3. Video Editing4. Hardware Connections5. Dashboard6. Resource gathering	<ul style="list-style-type: none">1. Code2. Slides3. Flask Setup4. Dashboard5. Data logging	<ul style="list-style-type: none">1. Code2. Slides3. Hardware Connections4. Design and creation of prototype.5. Dashboard	<ul style="list-style-type: none">1. Content for a few slides. <p>(Samuel did more than him)</p>

APP DEMO

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Link: <https://help.realvnc.com/hc/en-us/articles/360003474552-How-do-I-get-started-with-RealVNC-Connect-on-Windows#authenticating-0-3>

Almost 16,000 devotees take up milk pots and kavadis at Thaipusam 2025. (2025, February 11). The Straits Times. <https://www.straitstimes.com/singapore/almost-16000-devotees-take-up-milk-pots-and-kavadis-at-thaipusam-2025>