CONTROLVID-19

ABSTRACT

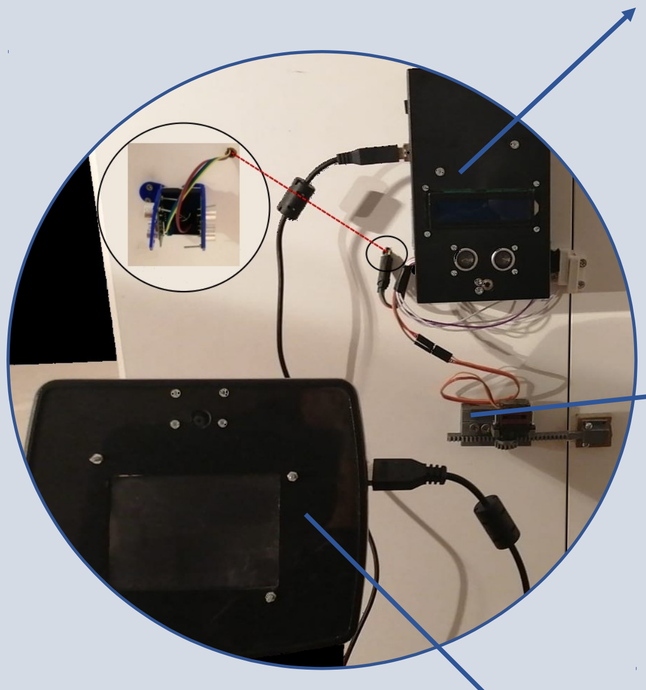
Due to COVID-19 pandemic, some precautions should be taken by both authorities and individuals. Some of these precautions are proper mask usage, symptom checking (cough, nausea, fever etc.) and social distancing. The CONTROLVID-19 grants the user to check the incoming people's masks and body temperatures. In addition to that, the user can define a quota for the people inside the compound. Social distance is the main measure on this quota.

***Keywords**: COVID-19, mask, fever, lock, pass, detection*

PROJECT DESCRIPTION

Among five projects, our team selected *'Surveillance-Protective Measures'* project as capstone.
The main purpose of this project is to reduce the spread of the virus by controlling the population in the building, preventing the entrance of the people suspected of being already infected or not taken necessary precautions such as proper mask usage.
The project requirements can be listed as following:

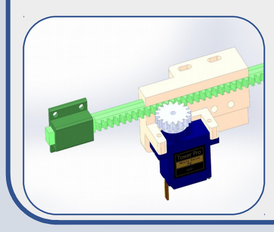
- The system denies entrance to risk-carrying people and gathers data for monitoring purposes.
- The systems checks if the person wears a mask properly and does not shows symptoms such as fever.
- The system denies entrance if these requirements are not fully satisfied, or the building is highly populated; and indicates the reason for denial.



TEMPERATURE MEASUREMENT SUBSYSTEM

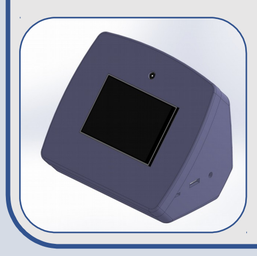
- A Hard Case
- 2x16 LCD Screen
- A Proximity Sensor
- IR Heat Sensor
- Arduino UNO

LOCK-PASSAGE SUBSYSTEM



- A Hinge Lock
- A Linear Actuator
- Magnetic Sensors
- An Indicator LED
- Proximity Sensors

SURVEILLANCE SUBSYSTEM



- A Hard Case
- 3.5'' TFT LCD Screen
- 1080p Camera
- Twin-fan Cooling System
- Raspberry Pi 4B 4GB

TECHNICAL SPECIFICATIONS

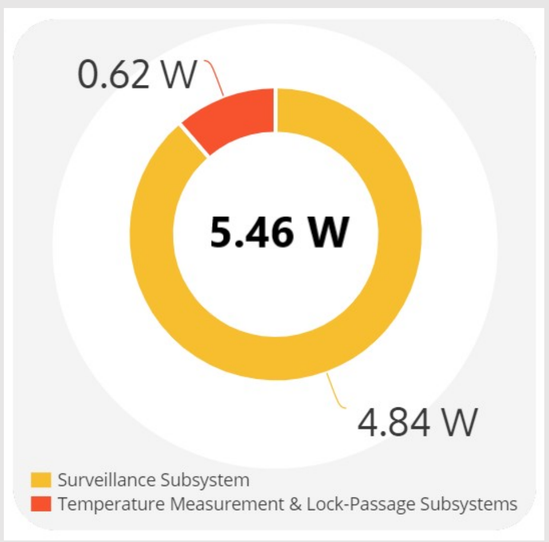
The system consists of three subsystems which are given below:

- **Surveillance Subsystem**:
  - ~2.5 FPS Video Screening
  - Face Detection with Haar-Cascade
  - Mask Detection with a trained model, MobileNetV2.
  - Raspberry Pi 4 communicates with Arduino UNO via Serial Port.
  - Box weighs less than 400 gr.
- **Temperature Measurement Subsystem**:
  - 10 temperature measurements are taken into account to increase accuracy.
  - Arduino UNO gathers the incoming & outgoing people data and the current headcount is displayed on 2x16 LCD and sent to the main computer.
- **Lock-Passage Subsystem:**
  - If all requirements listed in the project description are satisfied, the lock opens or closes.
  - For two gate scenario (entrance & exit gates are separate), two proximity sensors counts entering and exiting people.

PERFORMANCE REQUIREMENTS

- Mask Detection must be done at most in 2 seconds with 90% accuracy while the subject and the camera has a distance of at least 30 cm and at most 100 cm with an angle of at most 10 degrees.
- Temperature detection must be done in at most 1 seconds with at most 0.5°C error while subject's hand and the sensor has a distance of at least 2 cm and at most 3 cm.
- Door needs to be unlocked or locked within at most 3 seconds.

POWER ANALYSIS



COST BREAKDOWN

Equipment	Quantity	Price
Raspberry Pi 4 4GB	1	$75
Pi 3.5'' LCD Screen	1	$25
PiCam 1080p Camera	1	$15
Temperature Sensor	1	$10
3D Printing	1	$10
Pi Cooling System	1	$5
Arduino UNO R3	1	$5
Screws, Nuts & Enclosure	1	$5
HC-SR04 Distance Sensor	4	$4
Servo motor	1	$3
Magnetic Sensor	1	$3
2x16 LCD Screen	1	$2
Cables & Resistors	-	$1
ENGINEERING COST		*$1584*
TOTAL COST		**$1747**

TEST RESULTS

Surveillance Subsystem:

- ***Training Validation Test***: The model yields around 98% validation.
- ***Real-Time Operation Accuracy Test:*** Results consistent for *no mask* and *proper mask* conditions. For *wrong mask* case, accuracy drops under low illumination.
- ***Angle & Distance Tests:*** Maximum angle (20) is obtained while looking downward. 15 degrees is the common range for every case. System distinguishes all cases from a distance of 1 meter.
- ***Frame Rate Test:*** Average frame rate counted is *2.53.*

Temperature Measurement Subsystem:

- ***Accuracy Test:*** The histogram created by normalized measurements has mean of 1.0005 and standard deviation of 0.003. Total error is approximated as 0.9%.
- ***Speed Test:*** In *250 ms*, the subsystem detects and prints the measured temperature.

Lock-Passage Subsystem:

- ***Mechanical Operation Test:*** Lock tongue moves switfly across the hinge.
- ***Delay Test:*** The subsystem accurately works according to given *2 seconds* delay.
- ***Counter Test:*** The subsystem counts accurately when the door surface is smooth enough.

System Integration Test:

- The subsytems work together without introducing any operational delay to each other.

WHY US?

- We are using an embedded solution which improves mask detection accuracy up to 98%.
- Our system concludes all decisions under 5 seconds.
- Despite its high accuracy, the monitoring system operates at low FPS levels; in another saying, low power consumption and longer operational period.
- We value people's privacy; snapshots taken are not recorded.
- Robust enclosure.
- In case of a shutdown, the system records previous headcount & offers it to user as an alternative.

ABOUT ZEYREK

We are five senior undergraduate students dedicated to propose and develop a solution for reducing the spread of coronavirus. The co-founders is listed below:

- Güray ÖZGÜR - CEO
- Çağdaş YARDIMCI - CIO
- Ege Ekin CANSIZ - CFO
- Kaya Mert POLATKAYA - COO
- Utkucan GENÇ - CMO

For more information: