FINAL LAB REPORT
GROUP 5
AUTOMATED ROOM CONDITIONING

MEMBERS:

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MOTIVATION OF THE PROJECT

- Smart sensors play an indispensable role by converting analog or natural signals into digitals. Multi-sensors and microcontrollers are more and more commonly implemented in industrial products and home appliances.
- Sensors and actuators are the most basic and primary electric mechanical elements in most machines, including robotics.
- We intend to use these multi-sensors to capture the ambience of the room making it possible to alter the states of electrical appliances.
- With the happening mega-trend development of IoT, it will be possible for people in the future to access and control various types of robotics and machines by solely using one smart control monitor. It becomes convenient and easy to operate electrical appliances from anywhere in the world.
- Using Android App as a remote control, can be helpful when you are outside of your home and want to control few appliances before you reach home or for older people to turn on/off home devices.

DESCRIPTION OF THE PROJECT

- We have developed an automated smart room conditioning whose main motive is to automate basic and some advanced flows commonly presented in our rooms.
- Also, each user can control home appliances using a remote in the form of Mobile application which also shows real-time data to the user.
- The main motive is to make the final product as portable and scalable as possible with just small tweaks being required for some other scenario.

FEATURES AND WORKING OF THE PROJECT

Gas leakage detection:

- Air Quality Sensor is used to detect any harmful gases present inside the room. If that happens, an alert message is sent to the owner via MQTT to open the windows/door of the room.
- The alert message is displayed as a pop-up notification in the Android App.
- An alarm (buzzer) will set on if gas leakage is detected via the air quality sensor.
- The air quality is also displayed in the app as “Air quality OK”, or “High pollution” based on the readings of the sensor.

Regulating Fans

- The speed of the DC fan is controlled based on current temperature of the room. Fan speed is also affected by the number of people present inside the room. If there is no one present inside the room for more than 30 seconds, then the fan is switched off.
- If more than four people are present, then the fan speed is increased by a factor of 1.2 and if more than eight people are present, then the fan speed is increased by a factor of 1.5.
- The fan can be manually switched off by a remote implemented in the form of an application. If the switch of the fan is on, then the fan works smartly based on the sensor readings, otherwise the fan would be switched OFF despite the sensor readings.
- The current temperature and humidity of the room is also displayed in the application so that we could see the changes in the speed of the DC fan based on that temperature.

Regulating Lights

- Via sensing the natural light with the help of digital light sensor, we adjust the luminous intensity of the LEDs.
- LEDs are also affected by the number of people present inside the room. If there is no one present inside the room for more than 30 seconds, then the lights (LEDs) are switched off.
- The LEDs can be manually switched off by a remote implemented in the form of an application. If the current status of the LED is ON, then the LEDs work smartly based on the sensor readings, otherwise the LEDs would be switched OFF despite the sensor readings.
- The luminous intensity of the LEDs is also displayed in the app based on the readings of the digital light sensor.

Regulating AC

- Infrared sensor (IR) is used for regulating the temperature of the AC based on the present condition of the room. This IR is user programmable and can also be used to control any IR remote based device such as projectors, music systems etc.
- Because of the programmed remote, we can switch ON/OFF the AC via that universal remote as well.

- An IR receiver circuit is implemented along with the Arduino and is integrated with the LCD (Liquid Crystal Display) circuit which is used to display the temperature of the AC.
- Also, if no one is present in the room for more than 30 seconds, then the power supply of AC will be turned off.
- If the number of people inside the room are greater than four, then cooling would be increased i.e. temperature of the AC would automatically decrease by a factor of 1.5.

Ultrasonic Sensor Usage

- We are also using an ultrasonic sonic sensor to detect whether the door is currently open or closed. Basically, the distance measured by the sensor would increase when the door status is open.
- If the door of the room is open and the AC is switched on, then a message is sent via MQTT regarding the inefficient cooling as a pop-up notification.

Image Recognition using Webcam

- Webcam is used to detect number of people in the room via Image Recognition. The count of people is used as a factor in various ways as described above.
- Since the processing speed of Raspberry Pi is quite slow, the input is sent to a server via MQTT for processing and the result is sent back to the Raspberry Pi for further actions.
- One of our laptops was used as a server containing a python file working both as a publisher (for sending the processed output) and a client (for receiving the image as an input in the form of a JSON file).
- The Raspberry Pi after receiving the signal sends that again back to the mobile application, and the number of people is displayed in the app as well.
- If the number of people is found to be zero, then the entire power supply of all the appliances such as LEDs, fan and AC would get shut down.

Android Application

- The entire regulating of the appliances can be controlled by a mobile-Application.
- The application serve two purposes, firstly acting as a client used to display the current ambience of the room including temperature and humidity of the room, amount of natural light present inside the room, status of the door I.e. whether it is open or closed, number of people present inside the room, and the pollution level.
- Secondly, it also works as a remote control for manually controlling the electrical appliances like Fan, LEDs and AC.
- In this way, the application works both as a publisher and a client for MQTT purposes.
- Push-up notifications are also received on occurrence of any major/emergency event like inefficient cooling, high pollution etc.

Acknowledgments

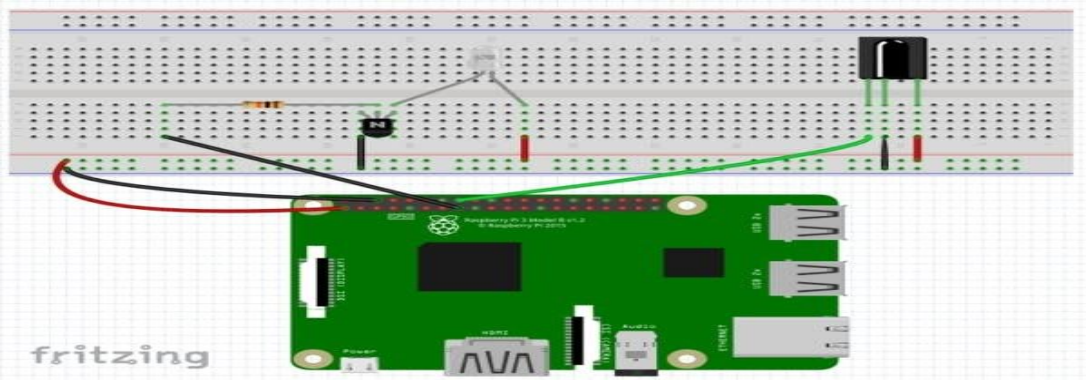
- Acknowledgements are received for any signal sent by the application. They are basically represented by a circle in the app. Green signal implies that the current status of that appliance is ON and red implies it is OFF.
- Due to this feature, the customer gets to know whether the appliance is faulty or the system is faulty. In the first case, the acknowledgement would be received but the appliance won't work. In the second case, the acknowledgement would not be received implying that the system is faulty.
- If the power is suddenly shutdown, then no data will be displayed on the app, just the labels of the fields would be displayed.
- Hence the user can infer these things by just having a look on our app which makes any kind of errors very easy to detect.

SENSORS/ACTUATORS REQUIRED

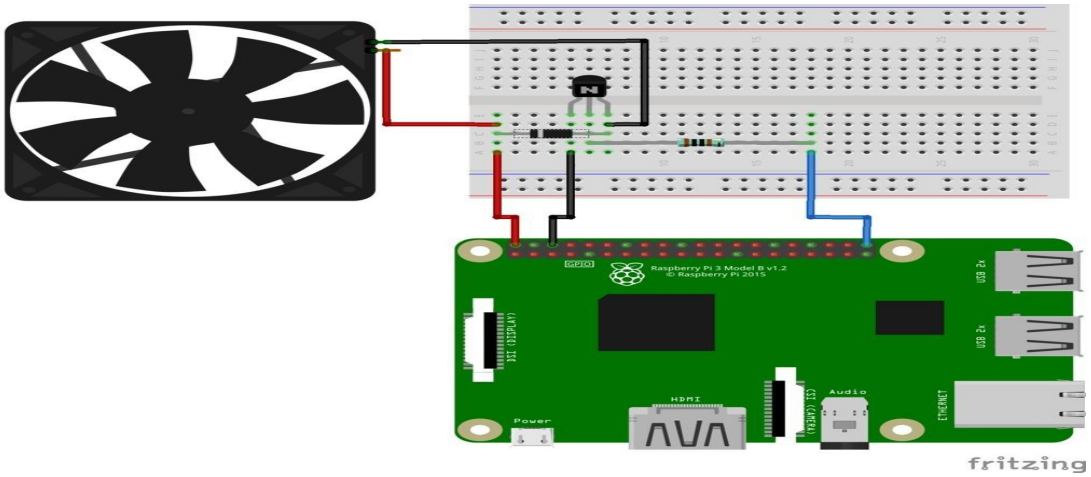
- Temperature and Humidity Sensor
- Digital Light Sensor
- Ultrasonic Sensor
- Air Quality Sensor
- Infrared (IR) sensor
- Webcam
- LEDs
- DC Fan
- LCD Display
- ADC (Analog-to-Digital Converter)

CIRCUIT DIAGRAMS

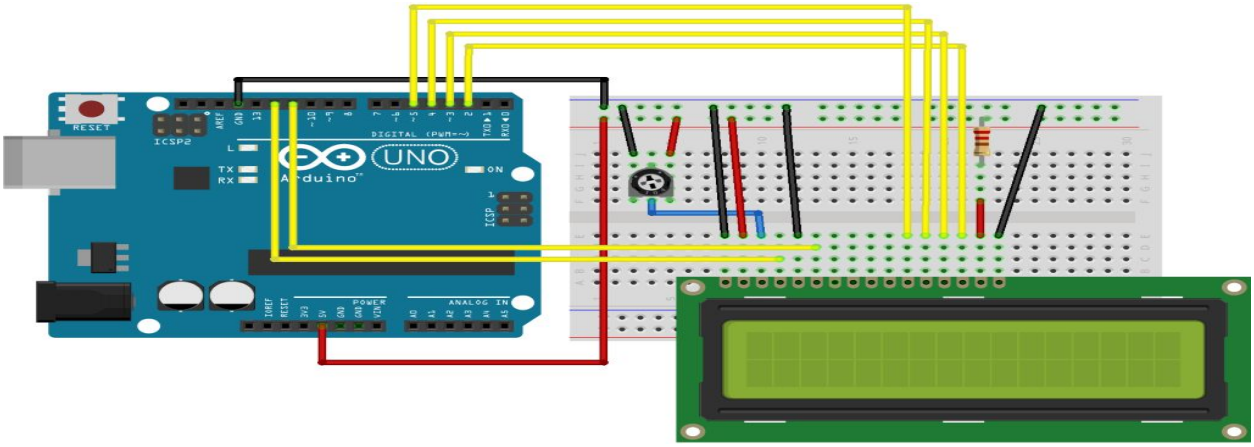
1. INFRARED CIRCUIT



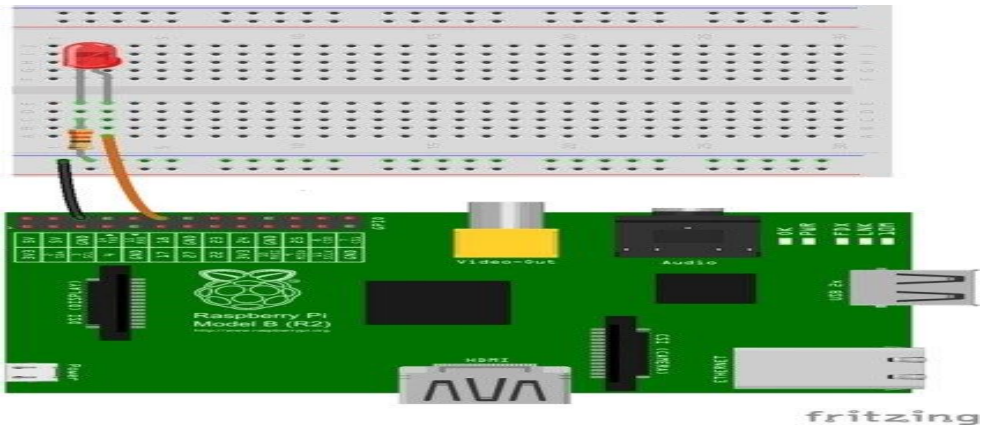
2. DC-FAN CIRCUIT



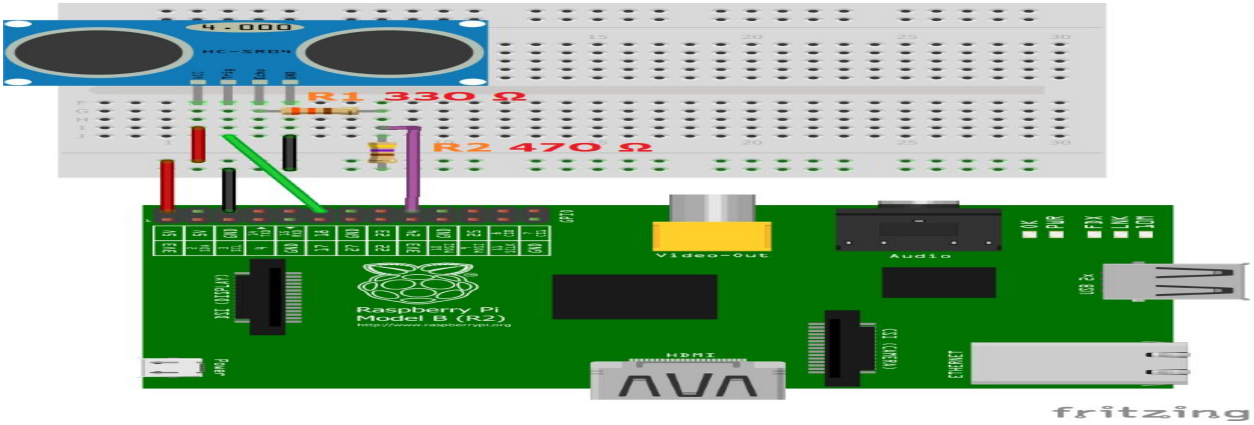
3. LCD DISPLAY CIRCUIT



4. LED CIRCUIT



5. ULTRASONIC SENSOR CIRCUIT



6. MOBILE APPLICATION

CONCLUSIONS AND DRAWBACKS

CONCLUSIONS

- We can use our system as a robust, scalable product which can be installed in any room since our system is portable and modular as new features can be integrated easily without interfering with the rest of the code/hardware.

DRAWBACKS

- Fluctuation of actuators: If the room temperature is say 25 deg. Celsius. The fan or AC would keep on fluctuating (decreasing / increasing in speed) as the temperature varies slightly around 25 deg. Celsius (I.e. 24.99 or 25.01) as 25 is a boundary case for changing the status of the fan/AC.
- Status of the door using ultrasonic sensor: The status of the door can be misinterpreted if we use the ultrasonic sensor in situations like presence of curtains, people etc. in front of the door. Even if the door is open, it will be displayed as closed because of our implementation design.

SCOPE OF FUTURE WORK

- We can use motors to automate the opening and closing of the doors depending on the number of people in the room and inefficiency of cooling.
- We can control various other electronic appliances such as television, refrigerator, home speaker systems, etc. using the infrared system we have built to control the AC, as our system simulates a universal infrared remote controller.
- We can tweak our product features to suit various other purposes such as classrooms, offices, auditorium, etc.