SELF ADAPTIVE ROBOTS IN HARMFUL CONDITIONS AND IT'S VIABILITY OF SELF SHEDDING

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Abstract-- **In this project, the robot gets adapted to two hazardous situations (Earthquake and Fire environments). Depending on the external factors, the robot identifies the situation, acts accordingly and detect the human under rubble. For optimized resource consumption and for better sensor-driven decision making the Internet of Things (IoT) is used. Instead of IR sensor, Grid-Eye infrared array sensor is used for human detection. In IoT, MQTT protocol is used for wireless data transmission from one place to other. This protocol connects the physical world devices and events with other servers and consumers'. The free server application can be installed in wireless connected devices like laptops and mobile. The IP address of each connected devices is linked with the web server in MQTT protocol. The information from the robot gets transmitted to the connected devices. With improved tracking of devices, they can benefit from the real-time environment and help them to take better decisions. With the help of this project, the robot can be employed in disaster management.**

Keywords- Human detection, Raspberry Pi, IoT MQTT protocol, End user applications.

INTRODUCTION:

A natural or human made disaster creates a negative impact on people and/or the environment, prompting the need to seek outside assistance. The first few hours after any disaster is crucial to rescue the affected people.Sometimes the humans gets trapped under the collapsed building and leads tothe inability of the rescue team to find the trapped people under the debris.To handle the different situations, the robot can be modified accordingly to reduce the loss of lives of people.

In the existing system,PIR sensor is used to detect human as we emit thermal radiation. But the disadvantage of using this sensor is when any obstacle is present in-between person and sensor sometimes it may fail to detect the person. Hence the Grid-Eye infrared array sensor is used to detect the human under rubbles of the building.

Most of the human detection robots uses Bluetooth, GPS or Zigbee module to control them. Hence it require separate Wi-Fi module. For better human-system interaction, IoT (Internet of Things) is used. To implement this Raspberry Pi with MQTT protocol is used asmicrocontroller which has more advantage when compared to others. It has inbuilt features like Wireless

LAN, Bluetooth, HDMI, USB ports, peripherals etc. MQTT (Message Queuing Telemetric Transport) is an ISO standard publish-subscribe based messaging protocol. It is used to transfer data in lightweight.

TECHNOLOGIES INVOLVED:

1) Grid-Eye Infrared Array Sensor:

Panasonic Grid-Eye thermal infrared array sensor [15] has 64 thermopile elements in an 8×8 grid format that detect absolute surface temperature without any contact. Compared to single element thermopile sensors and pyro electric sensors, it is not only possible to detect moving people and objects but also the position and presence of motionless people and objects, the direction of movements and the accurate surface temperature from -20°C up to +100°C.

2) APP for End Users:

In IoT, MQTT protocol connects the physical world devices and events with other servers and consumers. MobaXterm, free X server application can be installed in wireless connected devices like laptops and desktops. For mobile we choose the application My MQTT which runs on the device for data transmission. The IP address of each connected devices is linked with the web server in MQTT protocol.

3) Raspberry Pi:

A Raspberry Pi is a general-purpose computer, usually with a Linux operating system, and the ability to run multiple programs. The official Operating System (OS) is Rasbian and comes preloaded with PYTHON IDLE (Integrated Development Environment). When compared with Arduino or PIC microcontroller, Raspberry Pi has inbuilt features like Bluetooth, Wi-Fi etc. It has Bluetooth Low Energy (BLE) feature which consumes low power and high data transmission takes place.
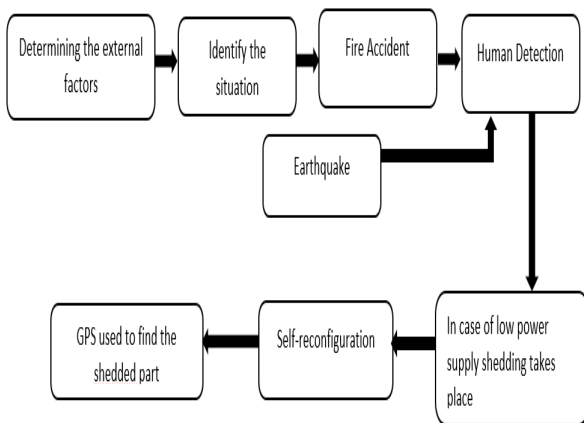
SYSTEM DESIGN:

A) OVERALL PROCESS:

Figure 1: Overall process

During the disaster, the robot first determines the external factors and identifies the situation. Depending upon the situation whether it is fire accident or earthquake, the corresponding sensors will indicate and alert the people. If in case the affected people gets trapped in the incident, the location of the trapped person is identified and sends emergency message to the rescue team. When actions takes place for prolonged time, then there will be low power supply and system becomes unstable. Hence shedding method is used to continue the actions even in low power state.
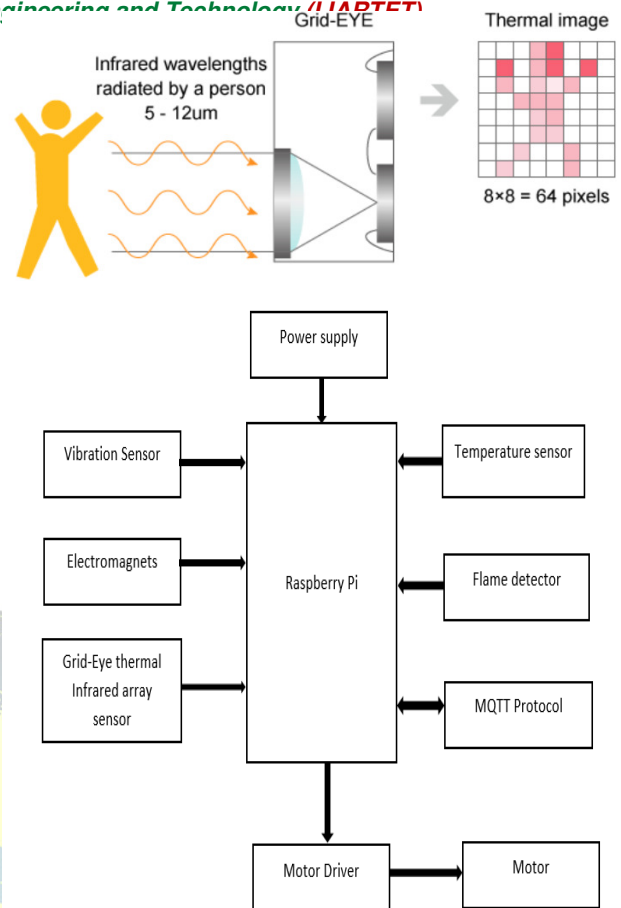
B) BLOCK DIAGRAM:

Figure 2: Block Diagram

Sensors:

The sensors that are used in this module are Vibration sensor, Temperature sensor and flame detector. They are mainly involved to identify the situation and indicate accordingly.

Grid-Eye Infrared Array Sensor:

Figure 3: Working of IR Array sensor

This sensor works by detecting infrared rays produced by the human and converts into temperature by producing thermal image in the form of 8*8 grid format. Unlike the IR sensor, it can also detect the movements of the person like in fig. 4
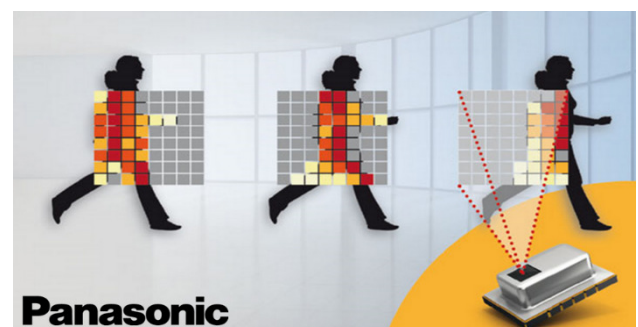

Figure 4: Thermal image of movement of person
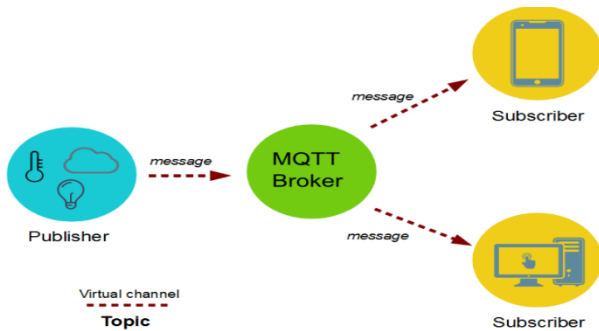
MQTT Protocol:

Figure 5: Working of MQTT protocol

To transmit the messages from the robot to the outside world, instead of GPS, Zigbee or Bluetooth IoT can be preferred. In IoT, MQTT protocol is accessed for the transmission of data. The IP address of the outside world (like computer, laptops, mobiles etc.) is linked with the Raspberry Pi IP address using this protocol. The information from the robot gets transmitted to the connected devices.

Motor and Motor Drive:

DC motor is used for the movement of the robot. Since the motor cannot be interfaced directly with microcontroller as it has high voltage motor drive is used. The function of the motor drive is to take low current control signal from the microcontroller and convert into high current signal to drive motor.
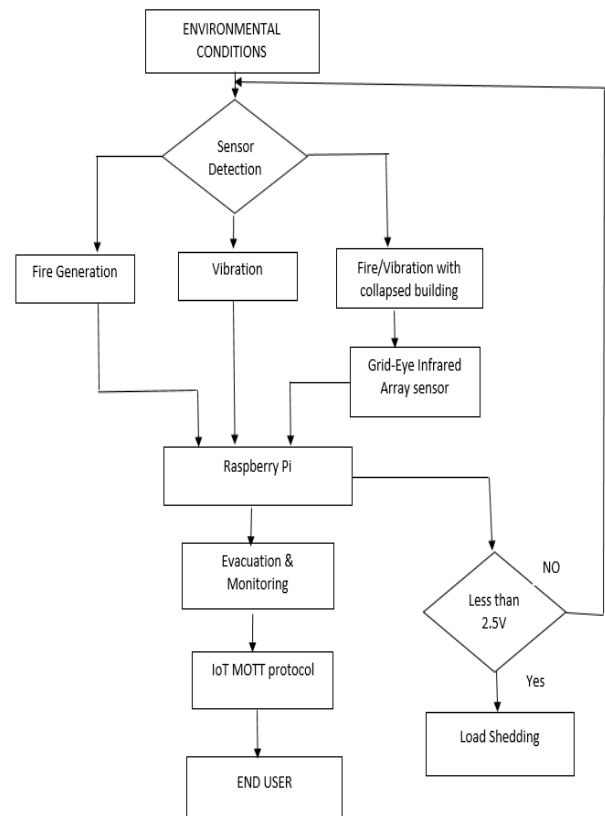
IMPLEMENTATION:

a) Process Methodology:

The flow process of work is shown in fig

Figure 6: Flowchart of process

b) Overview of the workflow:

When the natural disaster (earthquake or fire accident) occurs, the robot determines the situation. If it is earthquake, vibration sensor will indicate due to the vibrations produced by seismic waves and if it is fire accident flame detector will indicate due to burning of the objects. In addition to it temperature sensor can be used to know the temperature value in hot surrounding.

Due to the disaster, the building gets collapsed and there are chances for people to get trapped under the rubbles. The advanced thermal sensor Grid-Eye Infrared Array sensor is used which detects the IR rays produced by humans and convert them into a thermal image. It also detect the movements of the people. More than Passive IR sensor, this can be preferred in such conditions.

Each sensor information is transmitted to microcontroller to proceed with evacuation process depending upon environmental conditions. These information is published using IoT protocol and the connected devices subscribed to get the messages of the robot. In mobiles MyMQTT app is used and in computers MobaXterm free Xserver application is used to get the transmitted data from the robot.
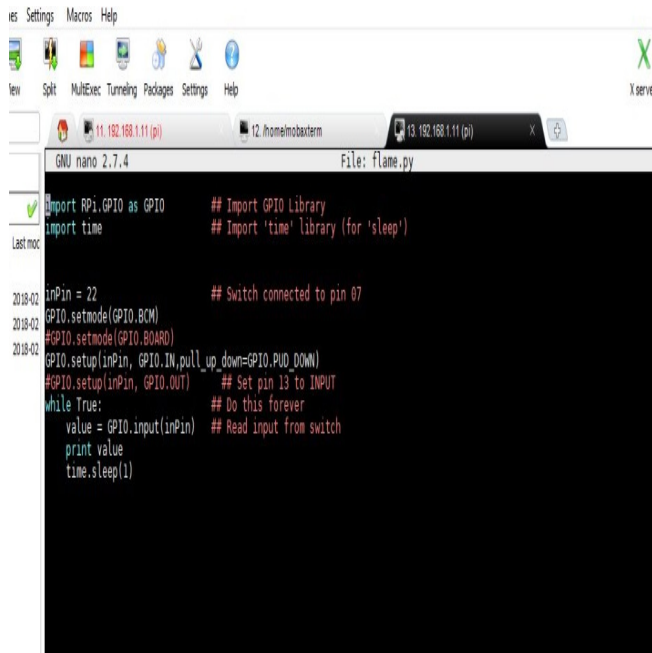
During prolonged hours of monitoring/evacuation process, there may be chances of low power supply. When there is reduced power supply, the system becomes unstable. To overcome this situation, loadshedding mechanism is introduced. The

components which are not in involved in process are made to shed by itself so that the process gets continued.

c) Programming:

Raspberry Pi OS has inbuilt PYTHON IDLE. So Python is used as programming. Some of the screenshots of the program that took while executing it in MobaXtermapplication are listed below
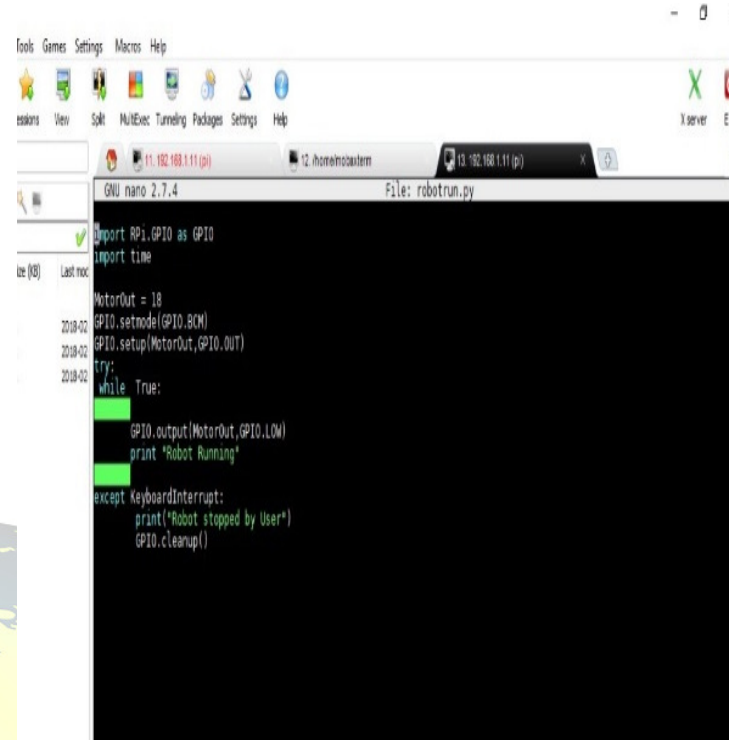

Figure 7: Program for sensor (vibration and flame detector)
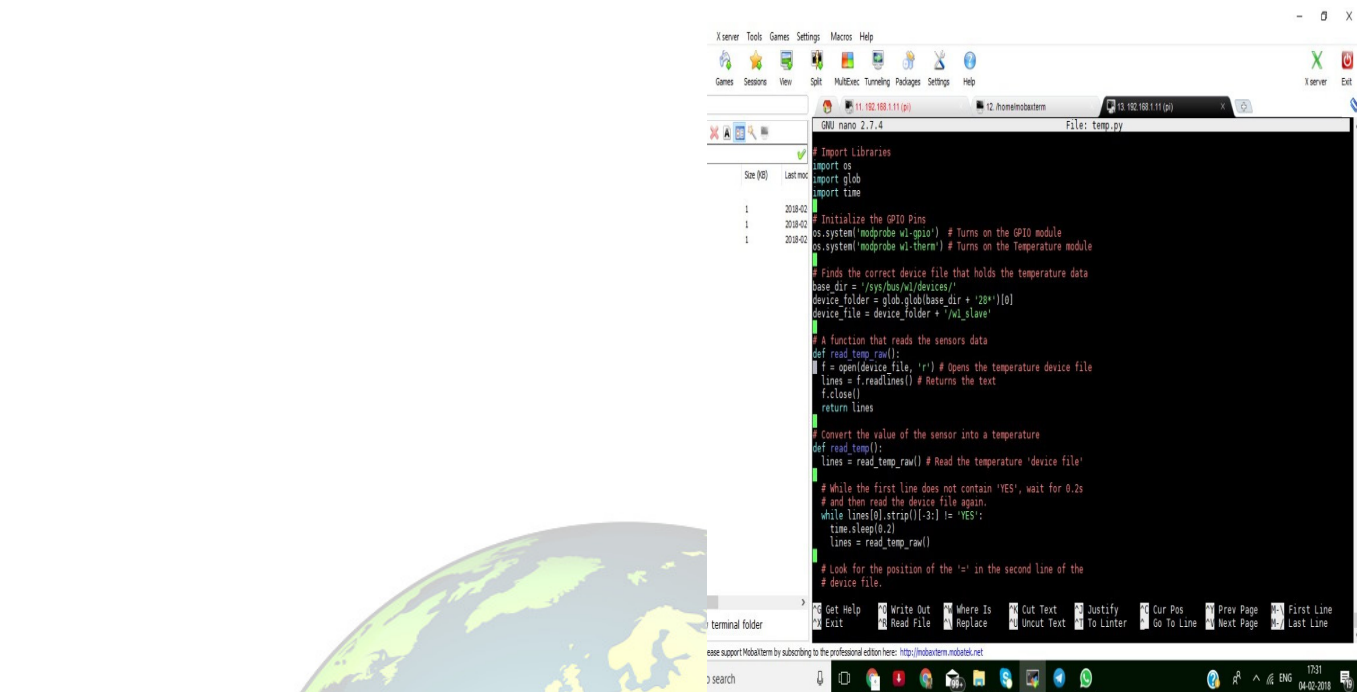

Figure 8: Program for motor
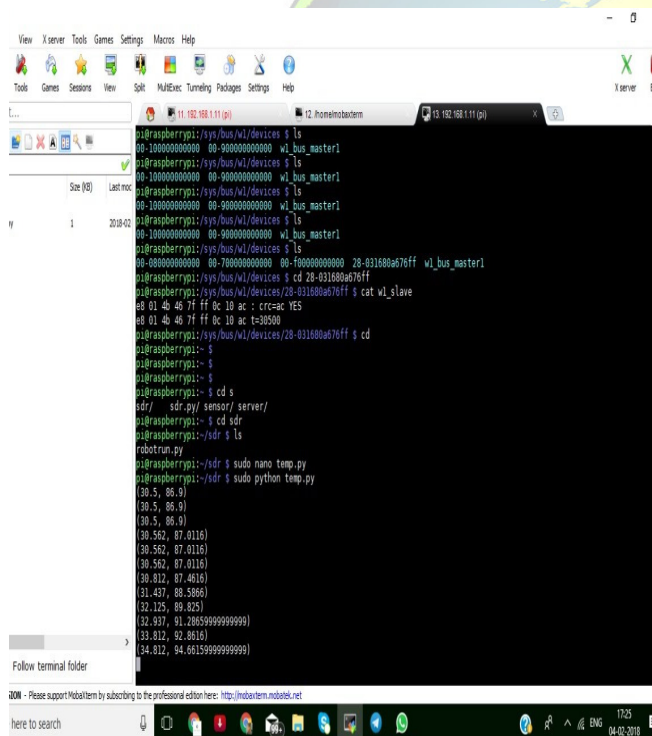
Figure 9 : Program for temperature

Figure 10: Output for temperature sensor

CONCLUSION

The human detection robot during natural disaster is designed and it can withstand in two different conditions-Fire accident and Earthquake. Self-adaptability is limited in this robot. It can perform the necessary actions only in two conditions. For data transmission instead of GPS, Zigbee and Bluetooth, Iot is used here by accessing its protocol. This robot can

manage even in low power supply state. Self-shedding method is used to overcome the unstable state. It will self-shed the inactive components during the process. Furthermore, the robot can be implemented that can self-adapt itself in all kinds of natural disaster in future.

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