

# IoT Based Wireless Multifunctional Robot for Military Applications

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## ABSTRACT

In this paper, we are presenting a proposed system for IoT Based Wireless multifunctional robot for military application with Raspberry pi 3 using MQTT protocol and it is done by integrating the help of various sensors, Cameras, Grippers and actuators into web application using MQTT and HTTP protocol. To develop and design we are using Raspberry pi3 embedded board with python programming & MQTT protocol. Using this system one can monitor and control the military robot from anywhere in the world. And it has various sensors like motion sensor to sense the existence of human, Inductive proximity sensor to detect landmines (metal), temperature sensor to sense the temperature and various gas sensors to detect hazardous gaseous in the environment. Whenever sensors detect, the raspberry pi will start publishing the data using the MQTT protocol and display on Web application and start streaming video using motion service.

**Keyword:** Raspberry Pi 3, IoT, MQTT, Motion service.

## 1. INTRODUCTION

In today's world, robotics is fastest growing and very interesting field. ROBOT has various input and output to sense the environment and take appropriate action. It has an infrared sensor which is used to sense the obstacles coming in between the path of ROBOT, Camera to capture the pictures of the environment and actuator like motors, grippers and arms to perform actions. With the development and research of technology, scientist has come up with invention of military robots. This makes soldier's life more secure on war field. Military robots are used to perform various risky task like monitor war field, diffuse live unexploded bombs, detect landmines and shoot enemies.

Nowadays, many countries take the helps of these robots to take dangerous jobs. These military robots appointed with the integrated systems like sensors, gripper, weapons, cameras and actuators. based purpose of robot it comes in different shapes and features.

## 2. FUNCTIONAL DESCRIPTION

The functions of the various working components are given below:

### 2.1 Raspberry Pi 3

Raspberry pi 3 is small credit card sized computer uses Advanced Reduced Instruction Set Computing Machine technology which reduces power consumption, heat and cost. Raspberry pi uses only 5v and 700mA power rating. Raspberry pi available in many variants named Raspberry pi A, Raspberry pi B, Raspberry pi B+, and Raspberry pi 3 B. Raspberry pi 3 B is the latest version and it runs on A 1.2GHz 64-bit quad-core ARMv8 CPU with 1 GB RAM. It comes with on board Bluetooth and Wireless LAN. It has memory card slot which is used for booting the operating system. It has four USB ports, one HDMI port to connect Monitor, 40 GPIO pins to connect different sensors and Actuator, on board Camera interface (CSI) and Display interface (DSI) to connect Camera module and display module. Raspberry pi also has VideoCore IV 3D graphics core to render high quality graphics.



Figure 1 Raspberry Pi 3

### 2.2 MQTT Protocol

The full form of MQTT is message queue Telemetry Transport protocol which is used for machine-to-machine and “Internet of Things” protocol. It was intended as very light weight messaging protocol uses publish-subscribe architecture. It used where very small footprint is required and network bandwidth is very limited. For example, it has been used in Wireless sensor communicating with Web Application via MQTT broker.

The MQTT messages are transferred asynchronously using the publish subscribe architecture. It works by exchanging the control packets and these control packets kept as small as possible. Each packet contains three part, variable header, fixed header and payload. Payload field contains the actual information. And the sized of payload can be up to 256 MB in sized.

The MQTT protocol supports three level Quality of Service as follows:

- QoS 0 - message send only once so message can be loss.
- QoS 1 - duplicates message can occur.
- QoS 2 – assured that message arrive exactly once.

The MQTT client communicates with each other through the MQTT broker. The work of MQTT broker is forward the to all the client except publisher of the message. In MQTT, to send the message there is need to create a topic and then publish message using that topic. MQTT broker forward these messages to only those clients who subscribed to that topic.

In our project, we are using Paho-python library to publish the sensor’s reading and receives commands from web Application. And using, JavaScript MQTT client library to subscribe MQTT topic on Web Application.

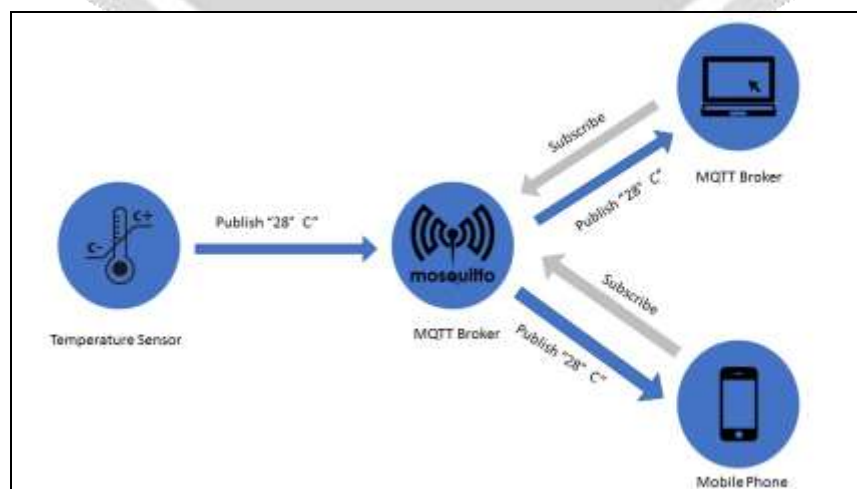


Figure 2 Architecture of MQTT

### 2.3 mjpg-streamer

mjpg-streamer is a command line tool that copies JPEG frames from one or more input plugins to multiple output plugins. It is to stream JPEG files over an IP-based network from a webcam to various types of viewers such as browser, players, and other software capable of receiving MJPG streams.

It was originally written for embedded devices with very limited resources in terms of RAM and CPU. Its predecessor "uvc\_streamer" was created because Linux-UVC compatible cameras directly produce JPEG-data, allowing fast and performant M-JPEG streams even from an embedded device running OpenWRT. The input module "input\_uvc.so" captures such JPG frames from a connected webcam.

## 3. IMPLEMENTATION DETAILS

The main of the system design is that military person can monitor the war field or risky area from the remote location, control the robot from remote location, detect landmine, diffuse unexploded bomb, target and shoot enemies using the Internet.

A python program is written to control the actuators like geared motor, gripper, gun mechanism etc. and get the reading from various sensors like Temperature sensor, Humidity sensor, PIR sensor, Thermal sensor, gas sensor, and the camera. The python program sends these data to the MQTT broker using the MQTT protocol using Internet. The MQTT broker is setup on the Ubuntu running on Amazon EC2. Then MQTT broker forward these data to MQTT clients i.e. Web Application developed using MQTT JavaScript library. Using HTML, CSS, JavaScript these data visualized on webpage.

It also streams the video using mjpg-streamer and YouTube live streaming to live streaming anywhere through the internet. Any Higher authority can control / monitor the robot from anywhere in the world.

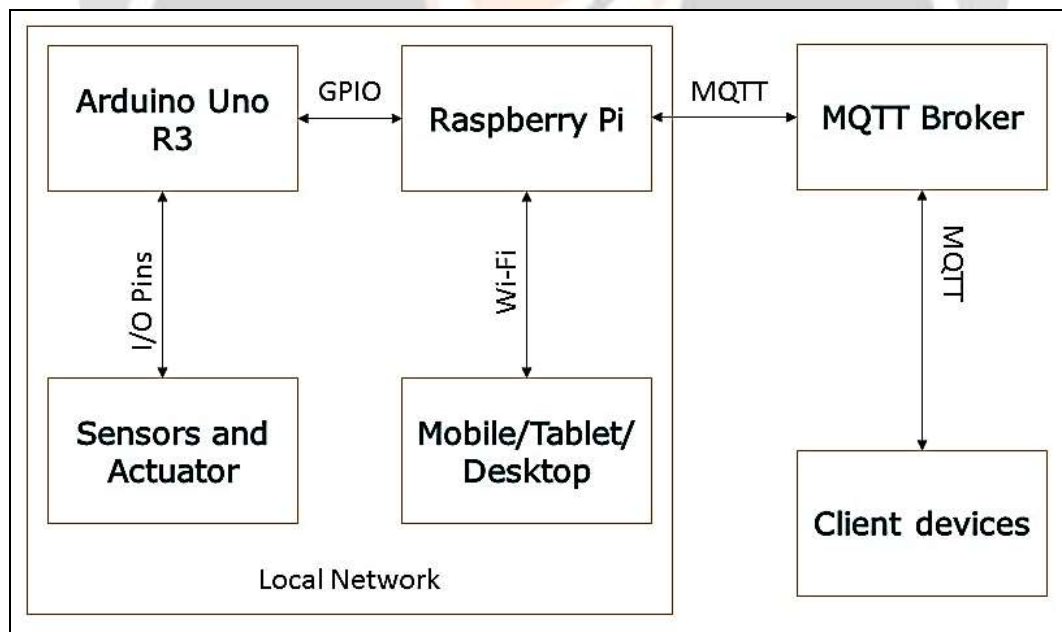


Figure 3 Block diagram of the system.

## 4. ALGORITHM

In the proposed system, we are using Raspbian operating system which is Linux based operating system. Raspbian support various programming languages like C, C++, Java, Python etc. but out of those, we are using Python programming language to control GPIO and communicate with MQTT broker using Internet. We are using Paho-mqtt Python library. Various functions of Paho-Python are used to create MQTT topic, to connect MQTT broker and Publish / Subscribe the data.

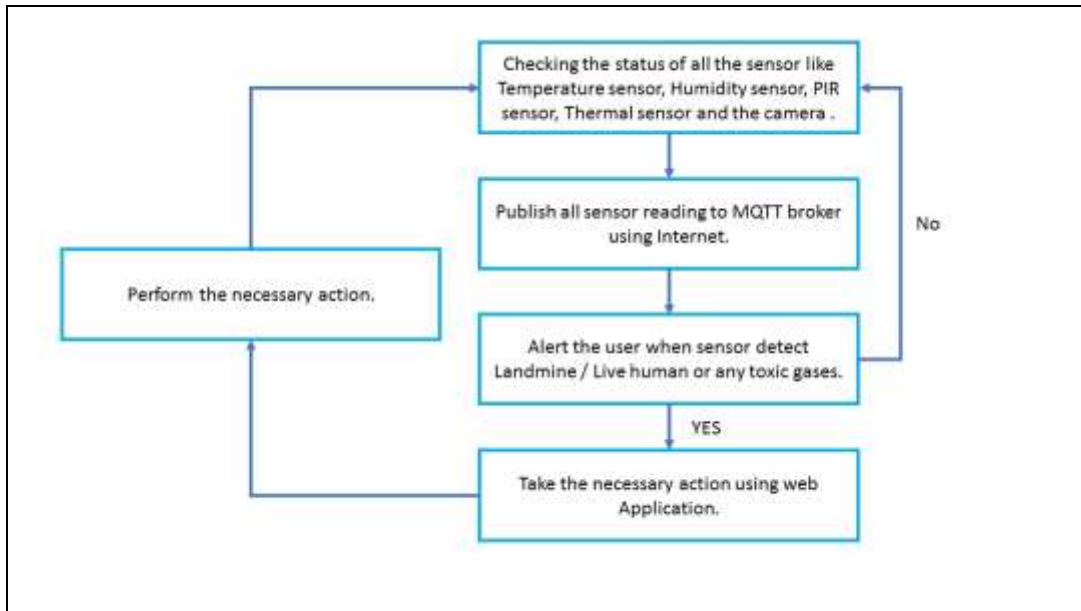


Figure 4 Algorithm for Military Robot

The proposed system is demonstrated using the following steps:

- Import all the module which are required like MQTT, Time, GPIO etc.
- Check the status of all the sensor and actuator.
- Create client instance of mqtt and using connect() function connect to the MQTT broker.
- To publish the sensor data using publish() method.
- After getting the value from sensors publish the sensor reading using the MQTT publish method.
- Use function disconnect() to disconnect from MQTT broker

### 5. RESULTS

Using the System user / Military person can control the robot from anywhere in the world using the Internet connection. The proposed system is practically used to monitor the war field / risky areas, to detect landmine, terrorist activities, toxic gases, temperature and explosive and following result are obtained.

Fig.5 shows the web Application containing the status of all the sensors.

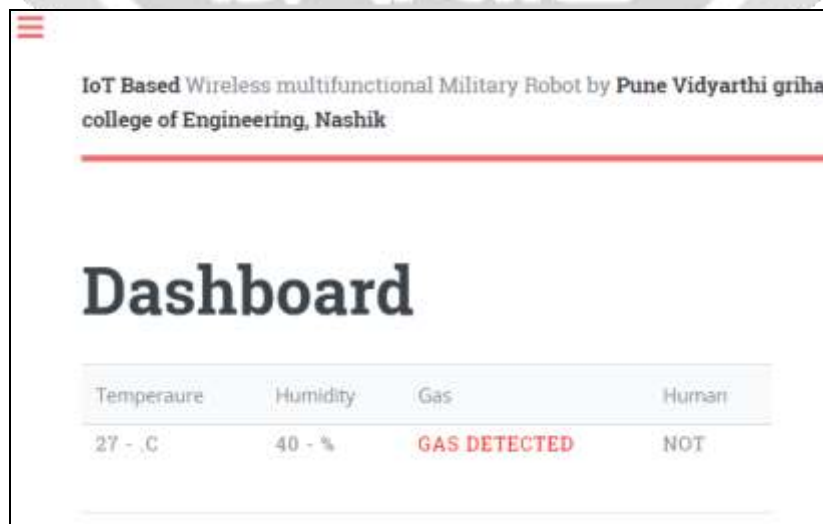
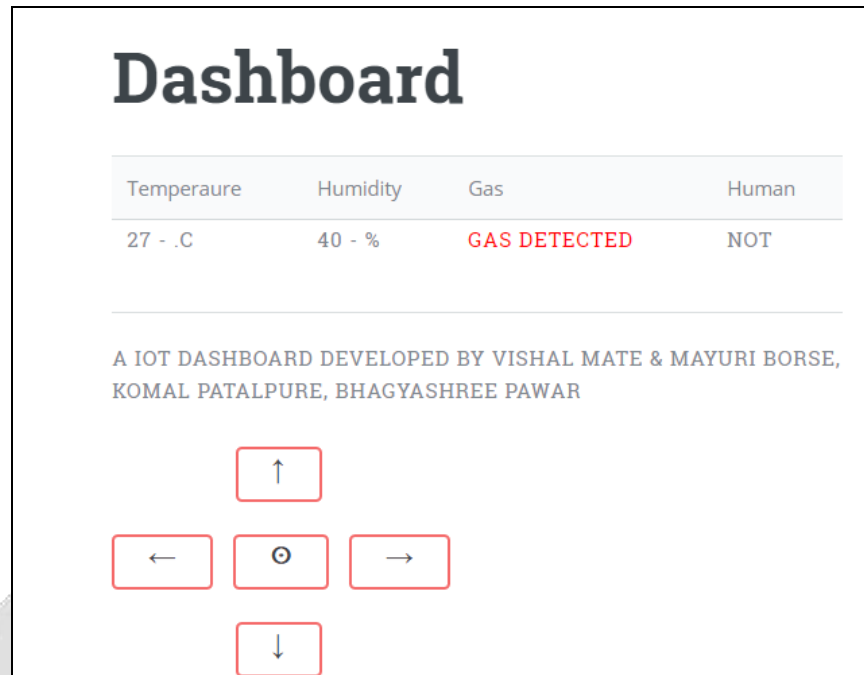


Figure 5 Status of sensors.

Fig.5.2 shows the Panel to control the robot from the remote location.



**Figure 6** Dashboard to control Robot

## 6. CONCLUSION AND FUTURE WORK

In this paper, we are designing an advanced military robot which monitor the war field / risky area and terrorist activities and saves soldier's lives. Our system also target and shoot enemies with the gun mechanism using Internet of Things (IoT). The future extension to the system is detect the faces of terrorist using image processing (OpenCV) and system may be alert other users about landmines, live bomb and terrorist activities and its geolocation.

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