International Journal of Scientific Research in Computer Science, Engineering and Information Technology
© 2019 IJSRCSEIT | Volume 5 | Issue 2 | ISSN : 2456-3307
DOI : https://doi.org/10.32628/CSEIT1952158

Quadcoptor Monitoring

M. Ganesan[1], S. S. Gayathri[2], S. Krishnakumari[2], S. Nivedithaa[2]
[1]Associate Professor, Department of Computer Science and Engineering, Sri Manakula Vinayagar Engineering College, Puducherry, Tamil Nadu, India
[2]UG Sholar, Department of Computer Science and Engineering, Sri Manakula Vinayagar Engineering College, Puducherry, Tamil Nadu, India

ABSTRACT

UAV technology has been an open research topic for many years. This is because of their potential huge benefits at an affordable cost in a wide range of tasks. UAV are commonly used in public and private places, yet also with few serious limitations. In this paper, we are going to design a drone that monitors the road traffic system as well as measures the pollution level emitted by the vehicle into the air. Most of the traffic monitoring systems based on UAV use a fixed trajectory to extract information about the vehicles, but we monitor the vehicle using the IP camera. During peak hours, the level of pollution will be higher so with the help of the drone we can measure the pollution level and take the required precautions.

Keywords: UAV, Quadcopter, Propeller.

I. INTRODUCTION

1.1 Internet of Things

Internet of Things is a network of connected physical objects that are accessible via the Internet. The 'thing' in the "Internet of things" can be a person with heart monitor or an automobile with a built-in sensor (i.e.) an object assigned with an IP address and it has the ability to collect and transfer the data over a network without manual intervention. The technology that has been embedded in the object helps to interact with the external environment. IOT refers to the general idea of things, especially everyday objects that are readable, recognisable, locatable, addressable through information sensing devices and/or controllable via the internet, irrespective of the communication means. The major goal of IOT is to enable things to be connected anyplace, anytime using any path/network and service.

It is said that the Internet of things is 16 years old. But the idea of connected devices has been around since the 70s. This idea was often called "embedded internet" or "pervasive computing". The actual term "Internet of Things" was coined by Kevin Ashton in 1999 during his work at Procter & Gamble. Ashton who was working in supply chain optimization wanted to attract senior management's attention to a new exciting technology called RFID (Radio Frequency Identification System). Since the internet was the hottest trend in 1999 and because it somehow made sense, he called his presentation "Internet of Things". Even though Kevin grabbed the interest of some P&G executives, the term Internet of Things did not get widespread attention for the next 10 years.

1.2 Vision

In 2005, ITU reported about a networking era in which all the networks are interconnected and everything from tires to attires will be a part of this

huge network. Just imagine yourself doing an internet search for your lost watch somewhere in your house.

This is the main vision of an IoT, where things are able to talk and whose data can be processed to perform desired tasks through machine learning. An article published in Network World revealed that IoT strategies are the top of IT vendors, they carried out some interviews from the key IT vendors. As of HP's vision, they see a world where people are always connected to their content. Cisco strongly believes in the industrial automation and convergence of operational technology. Intel is focusing on empowering billions of existing devices with intelligence. Microsoft does not consider IoT as any futuristic technology; they believe that it already exists in today's powerful devices and that the devices just need to be connected for a large amount of information which could be helpful. While IBM has a vision of a Smarter Planet by controlling the devices remotely via secured servers. Despite having various visions, they all agree to a network of interconnected devices, therefore more developments within the coming decades are expected to be seen including that of a new converged information society.

1.3 IOT Architecture

More than 25 Billion things are expected to be connected by 2020 which is said to be a huge number, so the existing architecture with TCP/IP protocols, adopted in 1980 cannot handle a network as big as IoT which caused a need for a new open architecture that could address various security and Quality of Service issues. Without a standard privacy assurance, IoT is not likely to be adopted. Therefore protection of privacy of users and data are key challenges for IoT.

For further development of the Internet of Things, a number of multi-layered architectures are proposed. The six layers of IoT are as below:

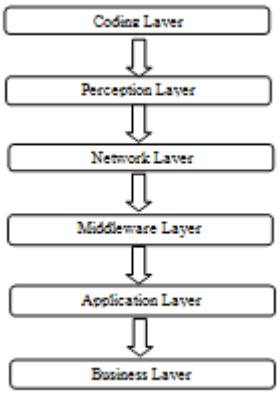

Fig 1. Six-Layered Architecture of IoT

1.3.1 Coding Layer

Coding layer is said to be the foundation of IoT which provides identification to the objects. In this layer, each object will be assigned a unique ID which makes it easy to discern the objects.

1.3.2 Perception Layer

This layer is a device layer of IoT which gives a physical meaning to each of the objects. It consists of data sensors in various forms like IR sensors, RFID tags or other sensor networks which could sense the Humidity, temperature, speed and location of the objects. Perception layer gathers useful information about the objects from the sensor devices linked with them. It then converts the information into digital signals which are passed onto the Network Layer for further action.

1.3.3 Network Layer

The purpose of the network layer is to receive some useful information from the perception layer in the form of digital signals and transmit them onto the processing systems in the Middleware Layer through the transmission mediums like Zigbee, 3G, Wife, and Bluetooth etc with protocols like IPv4, ipV6, MQTT, DDS etc

1.3.4 Middleware Layer

Middleware layer processes the information received through the sensor devices. It includes technologies

like Ubiquitous, Cloud computing, which ensures direct access to the database to store all the necessary information in it. Using some Intelligent Processing Equipment, the information is processed and a fully automated action is taken based on the processed results of the information.

1.3.5 Application Layer

Application layer realizes the applications of IoT for all kinds of industry, based on the processed data. Because applications promote the development of IoT, this layer is very helpful in the large scale development of the IoT network. The IoT related applications could be a smart planet, smart homes, smart transportation etc.

1.3.6 Business Layer

Business layer manages the applications and services of the IoT and is responsible for all the research related to IoT. It generates different business models for effective business strategies.

1.4 Application

Most of the daily life applications that we normally see are already smart but they are unable to communicate and share useful information with each other, which will create a wide range of innovative applications. These emerging applications with some autonomous capabilities that would certainly improve the quality of our lives. A few of such applications are already in the market, let's take the example of the Google Car which is an initiative to provide a self-driving car experience with real-time traffic, road conditions, weather and other information exchanges, all due to the concept of IoT. There are a number of possible applications that can be of great advantage in future. In this section, we present a few of these applications.

1.4.1 *Smart Traffic System*

Traffic is said to be an important part of a society, therefore all the related problems must be properly addressed. There is a need for a system that will improve the traffic situation based on the information obtained from objects using IoT technologies. For such an intelligent traffic monitoring, the realization of a proper system for automatic identification of vehicles and other traffic factors is very important for which we need IoT technologies instead of using common image processing methods.

1.4.2 *Smart Environment*

Prediction of natural disasters such as flood, fire, earthquakes etc will be possible due to innovative technologies of IoT. There will be regular monitoring of air pollution in the environment.

1.4.3 *Smart Home*

IoT also provides DIY solutions for Home Automation with which we will be able to remotely control our appliances as per our basic needs. Regular monitoring of utility meters, energy and water supply will help saving resources and to detect unexpected overloading, water leaks etc. There will be a proper detection system which will prevent burglaries. Gardening sensors will be able to measure the moisture, light, humidity, temperature and other gardening vitals, as well as it will water the plants according to their needs.

1.4.4 *Smart Hospitals*

Hospitals will be generally equipped with smart flexible wearable embedded with RFID tags which will be given to the patients on arrivals, through which not only doctors but also nurses will also be able to monitor the patient's heart rate, blood pressure, temperature and other conditions both inside and outside the premises of the hospital

1.4.5 *Smart Agriculture*

This will monitor the Soil nutrition, Light, Humidity etc and improve the green housing experience by automatic adjustment of temperature to maximize the production. Accurate watering and fertilization will help in improving the water quality thus saving the fertilizers respectively.

1.5 Key Characteristics of IoT

The fundamental characteristics of the IoT are as follow:

Intelligence: IoT comes with the combination of the algorithm, software & hardware that makes it smart. Ambient intelligence in IoT enhances its capabilities which facilitate the things to respond in an intelligent way to a particular situation and support them in carrying out specific tasks.

Dynamic Nature: The primary activity of IoT is to collect the data from its environment; this is achieved with the dynamic change that takes place around the devices. The state of the device changes dynamically e.g., sleeping and waking up, connected and disconnected as well as the context of devices including location and speed.

Enormous scale: The number of the device that needs to be managed and that communicate with each other will be at least an order of magnitude enlarger than the devices connected to the current Internet. Even more critical will be the management of the data generated and their interpretation for application purpose. This relates to the semantics of data, as well as efficient data handling.

Heterogeneity: Heterogeneity in the Internet of Things is one of the key characteristics. The device in the IoT is heterogeneity, as based on different hardware platform and networks. They can interact with others device or service platform through a different network.

Interconnectivity: With regards to IoT, anything can be interconnected with the global information and communication infrastructure.

Things-related services: The IoT is capable of providing thing-related services within the constraints of things, such as privacy protection and semantic consistency between physical things and their associated virtual things. In order to provide things related services within the constraints of thing, both the technologies in the physical world and information world will change.

Safety: As we gain benefits from the IoT, we must not forget about safety. As both the creators and recipients of the IoT, we must design for safety. This includes the safety of our private data and the safety of our physical conditions. Securing the network, the data, and the endpoint moving across all of it means creating a security paradigm that will scale.

1.6 IoT technology

The Internet of Things builds on three major technology layers:

1. Hardware (including chips and sensors)
2. Communication (including mostly some form of wireless network)
3. Software (including analytics, data storage and front end applications).

The reason for the Internet of Things is coming up so quickly, that there have been major technological advancements in all three of these technology layers:

Hardware

Costs of the sensors have declined by 54% over the past 10 years. Moreover, factors are shrinking quickly. The Complete sensor packages that are smaller than the fingertips have become a standard.

Communication

Mobile devices have become a commodity for the wider public. At the same time, the cost of bandwidth has declined by 97% over the past 10 years.

Software

The cost of processing has even declined by 98% in the same timeframe. Moreover, a number of big data infrastructure and big data tools such as efficient databases have emerged over the last 5 years.

There are various technologies and competing products. From MEMS accelerometers to Raspberry Pi development boards, from Zigbee communication to next-generation LTEM, and from column-based databases to streaming analytics engines. Each of these concepts, technologies, and products could fill a whitepaper on their own.

II. RELATED WORKS

From the various researches, observed that there are some relevant works which similar to the current proposal whose ideas, works and drawbacks are listed below:

(Mouna Elloumi April 2018) In this paper, they introduce a vehicle detecting and tracking system based on image data collected by UAV. The system uses consecutive frames to generate a vehicle's dynamic information, such as positions and velocities. They developed four major modules they are image registration, image feature extraction, vehicle shape detecting, and vehicle tracking. Some unique features had introduced into the system to customize the vehicle and traffic flow and to jointly use them in multiple consecutive images to increase the system accuracy of detecting and tracking vehicles. Field tests demonstrate that the present system exhibits very high accuracy in traffic information acquisition at different UAV altitudes with different scopes, which can be used for future traffic monitoring and control in metropolitan areas.

(Liang WangMay2016) In this paper, they proposed a road traffic monitoring system using multiple UAVs. Nowadays, Unmanned Aerial Vehicles (UAVs) are becoming an attractive solution for road traffic monitoring because of their low cost, mobility and broad view range. Till now, existing traffic monitoring systems based on UAVs use only one UAV with a fixed trajectory to extract information about vehicles. They develop a method to generate adaptive UAVs trajectories, which is based on the tracking of moving points in the UAV field of view. Also, they generate UAVs trajectories using mobility models that are usually used to model vehicles mobility. UAVs monitor the traffic on a city road, they are also responsible for collecting and sending vehicle information to a traffic processing centre for traffic regulation purposes. They showed that the performance of their system is better than the performance of the fixed UAV trajectory traffic monitoring system in terms of coverage rates and events detection rates.

(Gian Marco Bollafeb2017) In this paper, they proved that the air pollution changes abruptly even at short distances both horizontally and vertically. Their aim is to provide a new tool to study air quality at different heights that even private citizens could find. They presented an overview of the project, a vertical drone for air pollution monitoring. They inherent to UAVs and environmental monitoring and looking at preliminary results. Wireless Sensor Network and low-cost sensors were discussed with specific reference to environmental monitoring. Finally, this project was presented by outlining its key features, introducing the plans, goals and challenges. That preliminary analysis points towards interesting potential uses of light drones for 3D monitoring.

(Tommaso Francesco Villa Dec2016) In this paper, they have said that data collection near pollution sources is difficult, particularly when sites are difficult, have physical barriers or themselves moving. Small Unmanned Aerial Vehicles (UAVs) offer new approaches to pollution and atmospheric studies.

They include two test: first test is to find the air flow behaviour of a hexacopter, its downwash and upwash effect, by measuring airspeed along three axes to determine the location where the sensors should be mounted; Second is to find the use of gas sensors for CO2, CO, NO2 and NO, and PNC monitor (DISC mini) to assess the efficiency as well as performance of the UAV based system by measuring emissions from a diesel engine.

III. EXISTING SYSTEM AND ISSUES

Road traffic has been a major problem in today's busy world. Although traffic signalling has been used effectively to clear the road traffic, it seems to be difficult to clear the traffic in the areas where there is no facility for traffic signalling and also in places where the accident has occurred. In this situation, some kind of information needs to be passed to the traffic police so that they clear the traffic from the place where they are.

To overcome this kind of problem a traffic monitoring system has been developed which has been fixed in a drone that collects the information of the vehicles that pass by in traffic places and pass it to the traffic police who control the traffic from their place. The signalling light will be fixed in the drone which will be controlled by the police. In the existing system, they use multiple drones which collect the information of the vehicle that comes from various directions and sends them to police. The issue in this project is that they use multiple drones that may be expensive and also if any one of the drone malfunction then there occurs some confusion in the information.

IV. PROPOSED SYSTEM

The idea behind the proposed system is to design an unmanned aerial vehicle (UAV) that monitors and controls the road traffic using the IP camera, senses the level of carbon monoxide emitted by the automobile and also finds the location of the drone using the Global Positioning System (GPS). The components used in this system is described below:

1. NodeMCU: It is an open source IoT platform used to interconnect the peripheral device which connects things easily.
2. LPC-2148 microcontroller: It is widely used IC from ARM-7 family, and it is pre-loaded with many inbuilt peripherals making it more efficient and reliable option for the beginners as well as the high-end application developer.
3. LiPo battery: Lithium Polymer battery or more correctly Lithium-ion Polymer battery is a rechargeable battery of lithium-ion technology using a high conductivity semisolid polymer electrode.
4. Brushless DC motor: It is also indicated as an electronically commutated motor or synchronous motor powered by DC electricity via an inverter or switching power supply which produces an AC electric current to drive each and every phase of the motor via a closed loop controller.
5. ESC: It is an electronic circuit that controls and regulates the speed of an electric motor. It may also yield dynamic braking and reversing of the motor.
6. Propeller: It is a type of fan that propagates rotational motion into thrust. It converts rotary motion from an engine or another power source, into a switching slipstream which pushes the propeller forward or backwards.
7. MQ3 sensor: It detects the presence of carbon monoxide in air concentration.
8. Lion battery: Lithium-ion battery is a type of rechargeable battery in which lithium ions move from the negative electrode to the positive electrode during discharge and back when charging.
9. H-Bridge motor: It is an electronic circuit that switches the polarity of a voltage applied to aloud.

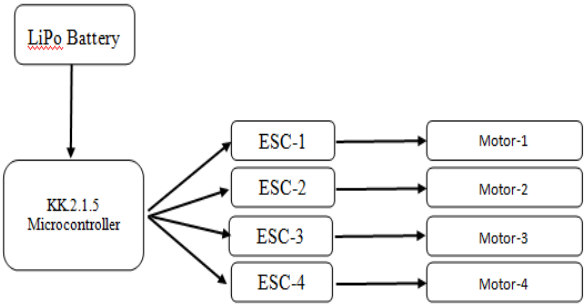

Fig.2 Block diagram of a quadcopter

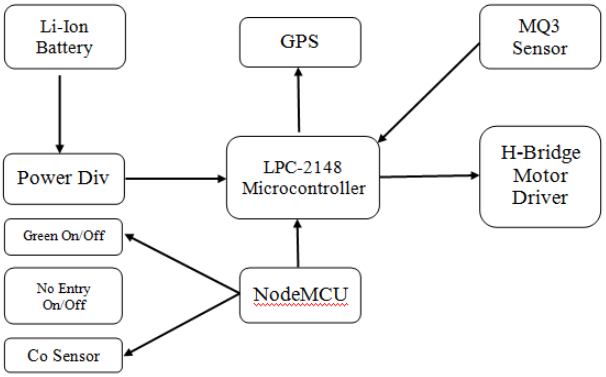

Fig.3 Block diagram of the proposed system

4.1 Quadcopter signalling

Quadcopter circuit consists of LIPO battery, KK 2.1.5 Microcontroller, Electronic Speed Controller (ESC), Brushless DC motor and propeller. To design this circuit, four DC motors are used at 1000 kilowatt power. This motor works on the principle of Newton's third law. The Electronic Speed Controller (ESC) balances the speed of the quadcopter to move gradually. KK 2.1.5 microcontroller is kept at the top of the circuit to control the quadcopter. Lithium Polymer battery is used to give supply to the quadcopter circuit. Propellers are kept in a diagonal way to make the quadcopter fly in a smooth manner. NodeMCU is used to connect all the required peripheral devices in an IoT platform. During the peak hours of traffic, the quadcopter is sent to the location for signalling purpose. By determining the exact location of the quadcopter, signalling is done. This process 9 done when the crowded areas are segregated at different places. At the time, the signal is sent to the required place which helps the people to move in a controlled manner and reduces the traffic.

4.2 CO level sensor

The major contributor to air pollution is passenger vehicles. Automobiles produce a considerable amount of nitric oxide(NO), carbon monoxide(CO), sulfur dioxide(SO2) and other hazardous air pollutants(toxic). Seventy-five per cent of vehicle pollutant is carbon monoxide. In this proposed system, we are finding the carbon monoxide level in the traffic zone through embedded MQ3 sensor. If the resultant carbon monoxide level is lesser than the threshold level, then no foresight measures are to be taken. In case resultant carbon monoxide level is higher than the threshold level, necessary precautions have to be taken.

4.3 Drone locator

Global Positioning System (GPS) is a satellite navigation system used to deliberate the foot station of an object. In this system, GPS is used to pick up the live location of the quadcopter. When the circuit establishes the low connectivity, there is a chance of disappearance of the quadcopter. Hence, GPS is used to track the location and identify where the quadcopter is present.

V. CONCLUSION

Road accidents and traffic congestions are becoming more common in today's busy world. This risks the life of the people to a greater extent. There are many emerging technologies that help to prevent accidents. But most of them are highly expensive. In our system, we have implemented integrated functionalities that help the users to avoid accidents and other mishappenings. Moreover, our system is more reliable than any other device that is currently available and it is less expensive.

VI. REFERENCES

[1]. Williams, R., Vasu Kilaru, E. Snyder, A. Kaufman, T.Dye, A. Rutter, A. Russell, and H. Hafner, Air Sensor Guidebook Washington, DC, 2014.

[2]. Samira Hayat, Evsen Yanmaz and Raheeb Muzaffar, Survey on unmanned aerial vehicle networks for civil applications: A communications viewpoint, Climate Change, 2008.

[3]. J. Wivou, L. Udawatta, A. Alshehhi, E. Alzaabi, A.Albeloshi and S. Alfalasi, Air quality monitoring for sustainable systems via drone based technology, Galle, 2016.

[4]. M. Carpentiero, L. Gugliermetti, M. Sabatini and G. B.Palmerini, A swarm of wheeled and aerial robots for environmental monitoring, Calabria, 2017.

[5]. A. Koval, E. Irigoyen and T. Koval, AR.Drone as a platform for measurements, Kiev, 2017.

[6]. T. F. Villa, F. Gonzalez, B. Miljievic, Z. D. Ristovski, and L. Morawska, A. M. Melesse, An Overview of Small Unmanned Aerial Vehicles for Air Quality Measurements: Present Applications and Future Prospectives, Sensors, 2016.

[7]. Patrick Haas, C. Balistreri, P. Pontelandolfo, G.Triscone, H. Pekoz, A. Pignatiello, Development of an unmanned aerial vehicle UAV for air quality measurements in urban areas, 2014.

[8]. K. Borre, D. M. Akos, et al., A Software-Defined GPS and Galileo Receiver: A Single-Frequency Approach, Springer, New York, 2007.

[9]. T. E. Humphreys, B. M. Ledvina, M. L. Psiaki, B. W. O'Hanlon, and P. M. Kintner, "Assessing the Spoofing Threat: Development of a Portable GPS Civilian Spoofer," Proceedings of the 21st International Technical Meeting of the Satellite Division of the Institute of Navigation, 2008.

[10]. S. Lu, D. Wang, X. Li, Z. Wang, Y. Gao, and Z. Peng. Three-dimensional distribution of fine particulate matter concentrations and synchronous meteorological data measured by an unmanned aerial vehicle (UAV), 2016.

[11]. C. Lin, Y. Li, A. K. H. Lau, X. Deng, T. K. T. Tse, J. C. H. Fung, C. Li, Z. Li, X. Lu, X. Zhang, and Q. Yu. Estimation of long-term population exposure to PM2.5 for dense urban areas using 1-km MODIS data. Remote Sensing of Environment, 2016.

[12]. Yi Wei Y., Lo Kin M., Mak Terrence, Leung Kwong S., Leung Yee and Meng Mei L., 2015.

[13]. G. Leduc, "Road traffic data: Collection methods and applications," Working Papers on Energy, 2016.

[14]. L. Wang, F. Chen, and H. Yin, "Detecting and tracking vehicles in traffic by unmanned aerial vehicles," Automation in Construction, 2016.

[15]. R. Reshma, T. Ramesh, and P. Sathishkumar, "Security situational aware intelligent road traffic monitoring using UAVs," in VLSI Systems, Architectures, Technology and Applications (VLSI-SATA), 2016.

[16]. E. N. Barmpounakis, E. I. Vlahogianni, and J. C. Go-lias, "Evaluating the accuracy of vehicle tracking data obtained from unmanned aerial vehicles," 2017.

[17]. D. Rosenbaum, F. Kurz, U. Thomas, S. Suri, and P. Reinartz, “Towards automatic near real-time traffic monitoring with an airborne wide-angle camera system," European Transport Research, 2009.

[18]. E. Yanmaz, R. Kuschnig, M. Quaritsch, C. Bettstetter, and B. Rinner, “On path planning strategies for networked unmanned aerial vehicles,” in Computer Communications Workshops (INFOCOM WKSHPS), 2011.

[19]. A. E. Abdulla, Z. M. Fadlullah, H. Nishiyama, N. Kato, F. Ono, and R. Miura, “An optimal data collection technique for improved utility in UAV-aided networks," in INFOCOM, 2014.

Cite this article as :

M. Ganesan, S. S. Gayathri, S. Krishnakumari, S. Nivedithaa, "Quadcoptor Monitoring", International Journal of Scientific Research in Computer Science, Engineering and Information Technology (IJSRCSEIT), ISSN : 2456-3307, Volume 5 Issue 2, pp. 895-903, March-April 2019. Available at doi : https://doi.org/10.32628/CSEIT1952158
Journal URL : http://ijsrcseit.com/CSEIT1952158