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Military Purpose Robot

Prof. S.S. Thorat[1], Gopal Dhanokar[2]

[1]Professor of Electronics and Telecommunication department GCOE, Yavatmal
[2]Student of Electronics and Telecommunication Engineering, Government College of Engineering, Yavatmal-445001, Maharashtra, India

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Abstract - In modern world many countries are working on different technologies. Hence, safety of soldiers and army personnel who fight for national security of their respective country need to considered. During warfare many of the soldiers lose their lives in abandoned areas or at borders. Landmines are an explosive weapon which may be or may not be buried under the soil and activated by a mere pressure of 9kg when someone steps on it. It also has an adverse effect on environment such as damage to soil structure, reducing soil productivity and increase vulnerability of soil to water and wind erosion. Mines also kill innocent civilians and soldiers after war ends. In order to save the lives of soldiers and diffuse the mines this paper is proposing a robotic vehicle with a metal detector which is capable of sensing mine ahead of it. It will also detect position of landmine and send latitude, longitude coordinates using GPS module. and also, Video surveillance is the process of monitoring a situation, an area or a person. This generally occurs in a military scenario where surveillance of borderlines and enemy territory is essential to a country's safety. Human surveillance is achieved by deploying personnel near sensitive areas in order to constantly monitor for changes. But humans do have their limitations, and deployment in inaccessible places is not always possible. We have developed a robot which can be used for video surveillance & monitoring which can be controlled through a GUI. The control mechanism is provided with a video transmission facility. The video transmission is practically achieved through high-speed image transmission. Initially, the robot will be equipped with a camera which will capture the scenes and transfer the images to the server on which the user will be controlling and watching the live feed.

***Key Words*:** Node MCU (ESP8266), GPS Module, Metal Detector, Motor Driver (L298N), ESP32-cam module, Surveillance Robot, landmine detection, fire detection, temperature and humidity sensing.

1.INTRODUCTION

Landmines are weapons or explosives that are buried under the soil that are activated by pressure, and may kill or cause harm when stepped upon it, and makes agricultural land unusable with the restriction of access to water. Landmines pose a serious threat to soldiers and civilians worldwide and also provide major problems to agricultural lands, water reservoirs and road development in border regions. The landmines are usually buried 10-40mm below the soil and requires about minimum pressure of 9Kg to detonate them. The face diameter of these AP mines ranges from 5.6 to 13.3cm. Landmines are broadly categorized into two types of landmines Anti-Personnel and Anti-Tank landmines. Anti-personnel landmines are used to injure a person since it contains fewer amounts of explosives which get activated when pressure is applied on it while soviet PFM also known as butterfly mine due to its shape, attract children who thinks it as a toy. The most common method is electromagnetic induction (EMI) based sensors can detect metal mines at a low cost; this method has been explored, and uses the electromagnetic characteristics of the mines or the mine casing. The use of electromagnetic sensor in the existing systems is extended to incorporate GSM method, prevails the limitation of restricted frequency and working area as the GSM provided a worldwide range with no interference with other controller. Several techniques such as GPS, infrared imaging, acoustic method, ultrasound technique, gamma rays' method, thermography methods are used for metal detection. This project aims at designing a landmine detecting robot that uses GPS technology and is controlled by the 328p microcontroller.

In this Project we basically use three module the first one is Node MCU ESP-32 cam which has inbuilt with two Bluetooth, one Wi-Fi, one antenna and inbuilt 2MP Camera. We will create a web-based interface to control the robot. The web server also provides the live streaming of what the robot "sees". It has five controls forward, backward, left, right and stop. Node MCU ESP32-cam inbuilt Wi-Fi module generates an IP address when it connected to the hotspot. We will open a browser on the IP address of ESP32- cam module and now we will able to control the robot. Designing of a Bluetooth or Wi-Fi controlled robot is main object of this project. Bluetooth technology has average range of 10 meter, due to which car cannot travelled long distances, Bluetooth controlled surveillance robot car has a distance (limited range) issue. We will solve this limitation by using Wi-Fi module. If we used Wi-Fi in our robot then connectivity and range can be improved. Another important of developing this project is we used web interface rather than traditional hardware controllers, by this we can reduce the cost. This wireless surveillance robot car is controlled via Wi-Fi module with the help of our smartphone and PC. Web Interface is developed by using programming on Arduino Ide. Node MCU ESP32- cam module uses a microcontroller to drive this

project. This microcontroller board provides ease in hardware interfacing and coding is done using Arduino IDE. An additional feature to this Wireless Surveillance Robot car is capturing a live streaming video. This video can be seen our smartphone and PC through Web Server. This robot can be used as a moving CCTV camera. This camera can also ensure security of the robot in case of obstacles.

2. LITERATURE SURVEY

1. Prof. R.M. Sahu the paper entitled as "Wireless Detection of Landmines using GPS & GSM", this system uses the Global Positioning System (GPS) tracking technology in combination with Global System for Mobile (GSM) technology. The system employing latest tracking techniques using satellite receiver in the form of GPS Modem, connected with a robotic vehicle can be used to detect the exact location of metal in the field. Then the GSM module transmits the received data to the authorized Mobile user. Main purpose of this project is to detect landmines by using a GPS enabled remotely controlled robot.

2. Prajakta Borole the paper entitled as "Border Surveillance Using IP Camera "For the competent working of remote control, a wireless camera is used so that user could see the accurate location of the robot and can send the robot where humans cannot go securely. Therefore, camera module is installed in proposed system. The camera chosen has good assortment of wireless transmission and displays the location in high quality output. The camera used in this system is FPV camera. A FPV is a type of digital video camera commonly employed for surveillance and which, unlike analog closed-circuit television (CCTV) cameras, can send and receive data via a computer network and the Internet.

3. Jovita Serrao and Awab Fakih - mobile operated vehicle: It's amotion in which a human can operate a vehicle remotely or wirelessly using an Android app without having to sit inside it. A car powered by a battery and a controller with Bluetooth connectivity is included in the project. The system is made up of a controller with a Bluetooth communication IC that will be connected to the vehicle's motors and other components. When an android app that is connected to this system via Bluetooth is turned on, the vehicle can be controlled via wireless orders from the app. Bluetooth's range of operation is around 10 meters or 33 feet.

4. Dr. S. Bhargavi and S. Manjunath Electronics and Communication: The goal of this research is to reduce human casualties in terrorist attacks like the one on September 11, 2001. The combat robot was created to deal with such heinous terror acts. This robot is radio controlled, self-powered, and equipped with all of the controls found in a typical car. It's been outfitted with a wireless camera so that it can keep an eye on the adversary from afar if necessary. It has the ability to enter enemy territory invisibly and transmit all information to us via its small camera eyes. This spy robot can be deployed at high- end hotels, shopping malls, and jewelry showrooms, among other places where intruders or terrorists may pose a threat.

5. S Meghana ; Teja V Nikhil ; Raghuveer Murali ; S Sanjana ; R Vidhya ; Khurram J Mohammad presented "Design and implementation of Surveillance Robot for outdoor security" published on 15 January in 2017 2ndIEEE International Conference on Recent Trends in Electronics , Information & Communication Technology (RTEICT).This paper presents us a modern approach for surveillance for outdoor security.

3. COMPONENTS AND DESCRIPTION

3.1 Node MCU

The Node Micro Controller Unit (Node MCU) is used as a gateway. It has inbuilt Wi-Fi module which is used to send the sensor data to cloud for storage and analysis. The main motive behind selecting Node MCU is that the sensors used in our project uses only digital pins and one analog pins are compulsory. Also, it consumes less power (3.3v) and is of low cost when compared to other microcontrollers /processors like Arduino and Raspberry pi. Node MCU is connected to metal detector sensor, servo motors, GPS module, L298N motor driver, etc.

3.2 L298N Motor Driver

It is essential to drive the motor accurately and it runs the required supply voltage and current to motors to drive it in clockwise and anticlockwise direction. L298N is used for this purpose and it works on H-bridge principle. The
motor driver works on 12v.

3.3 Global Positioning System (GPS) Module

Global Positioning System (GPS) satellites Transmission signals from space that GPS receivers use to provide three-dimensional location latitude, longitude and altitude. Once the robot detects the location of landmine, it comes to stop position. The location of the landmine is given through GPS sensor. The GPS sensor contains an antenna to get the longitude and latitude value over a blynk app.

3.4 ESP32 cam module

For the proficient working of remote control, there was a requirement to attach a wireless camera so that user could see

the precise location of the robot and can send the robot where humans cannot go firmly. Therefore, camera module is installed in planned structure. The camera chosen has good collection of wireless transmission and displays the location in high quality. The camera used in this system is IP camera. An IP camera is a type of digital video camera commonly hired for surveillance, and which, unlike analog closed-circuit television (CCTV) cameras, can send and receive data via a computer network and the Internet. In this new system, the network manager does not need to be in one place, as these cameras can be accessed over the internet. It also requires a personal computer or mobile to configure your camera and an internet-connected video device to act as a remote viewing station.

3.5 Metal Detector

This LC Metal detector non-contact metal induction detection module as a metal detector. When it approaches any metal, it makes a sound.

This is a module specifically designed to detect metal. The module operates by inducing currents in metal objects and responding when it occurs. A nice onboard buzzer signals when it detects something and an onboard potentiometer allow adjustment of sensitivity.

The power cables of the Metal detector non-contact metal induction detection module will need soldering on for the module to function, positive to the outside of the module and negative between the potentiometer and an electrolytic capacitor.

3.6 DC Gear Motor

DC Motor is a device that converts any form of energy into mechanical energy or imparts motion. In constructing a robot, motor usually plays an important role by giving movement to the robot. Here 4 DC motor are used to drive the robot.

3.7 Flame Sensor

A flame-sensor is one kind of detector which is mainly designed for detecting as well as responding to the occurrence of a fire or flame. The flame detection response can depend on its fitting. It includes an alarm system, a natural gas line, propane & a fire suppression system. This sensor is used in industrial boilers. The main function of this is to give authentication whether the boiler is properly working or not. The response of these sensors is faster as well as more accurate compare with a heat/smoke detector because of its mechanism while detecting the flame.

3.8 DHT11 Sensor

DHT11 is a low-cost digital sensor for sensing temperature and humidity. This sensor can be easily interfaced with any micro-controller such as Arduino, Raspberry Pi etc. to measure humidity and temperature instantaneously.

DHT11 humidity and temperature sensor is available as a sensor and as a module. The difference between this sensor and module is the pull-up resistor and a power-on LED. DHT11 is a relative humidity sensor. To measure the surrounding air this sensor uses a thermistor and a capacitive humidity sensor.

3.9 LCD Display 16*2

The term LCD stands for liquid crystal display. It is one kind of electronic display module used in an extensive range of applications like various circuits & devices like mobile phones, calculators, computers, TV sets, etc. These displays are mainly preferred for multi-segment light-emitting diodes and seven segments. The main benefits of using this module are inexpensive; simply programmable, animations, and there are no limitations for displaying custom characters, special and even animations, etc.

4. WORKING

4.1 Landmine detection and GPS module system

The robotic vehicle consists of Node MCU (ESP8266) connected with four wheels for the movement of the vehicle over the land in clockwise and anti-clockwise direction. In front side of robotic vehicle metal detector is placed which can sense mine ahead of it. When a Landmine is detected the robotic vehicle halts at that position and activates the GPS module. The GPS data is extracted online to get the latitude and longitude information of a particular location and transfer it to the blynk app at the controlling end. The ESP8266 Wi-Fi Module is a self-contained SOC with combined TCP/IP protocol stack that can give access to your Wi-Fi network. The ESP8266 is proficient of either introducing an application or offloading all Wi-Fi networking functions from other application. Which gets the latitude and longitude location through online access and give it to the blynk app. The system consists of two main modules, which are control station which runs on a PC or mobile and remotely controlled robot. The control station consists of three integrated modules consisting of Metal detecting component, GPS data collecting component and Remote-control component. These three components act as one system but the original system components act as instantaneously working autonomous systems.

4.2 Surveillance robot using ESP32 cam module

This robot has basically three module the first one is ESP32-cam module the second one motor driver module and the third one TP5100 which can be used as power supply and charge management module. This project aims are designing a robot which can be controlled wirelessly via Wi-Fi module with help of our smartphone and PC. This robot has five controlled (go, back, left, right, stop) and capable of moving in all four directions. The main advantages of this project are economically low. This wireless controlled robot can be used for different sophisticated robotic applications. This wireless robot can be controlled by Node MCU ESP32-cam microcontroller. The data sent by our smartphone and PC can be received over Wi-Fi module which is connected to our microcontroller.

4.3 Fire detection system

A fire alarm system is an active fire protection system that controls all the fire alarm modules in a building. It is composed of alarm initiating devices (smoke detectors and heat sensors), alarm notification appliances (sirens or devices that produce loud noises), fire control units (sprinkler systems or fire extinguisher systems), power supplies and wirings. The fire alarm system can be set off automatically by smoke detectors, heat detectors or manually. These sensors are set to detect certain levels of heat or smoke that could be an indication of fire. A loud bell or a siren sometimes accompanied by blinking or flashing lights for individuals who have hearing problems, blasts to alert occupants in the building. To truly understand how a fire alarm system works, let us go further into the components of the fire alarm system. In a fire alarm system, there is always a smoke detector to detect smoke or fire. The process of this system When this system is powered on, the Node mcu board connects to the Blynk cloud through the internet. Then, we can turn ON and OFF this system using the Blynk app interface. When the system is activated, the smartphone receives a push notification as soon as the red LED and buzzer is activated in the event of a fire. Afterward, the system goes back to normal. Then the green LED bulb is activated.

4.4 Temperature and Humidity sensing system

This system is designed to meet the purpose and demand of society by using IoT to monitor and check temperature and humidity in an military purpose. The system employs temperature and humidity to detect temperature and humidity increases. The sensors sense the temperature and humidity, send the results to NodeMCU, which processes the data and then sends it to the mobile application (blynk app). With this system, not only the authorities, but also the localized people can check the transmitted data via their mobile phone, and the temperature and humidity values will be displayed on the LCD display.

5. TOOLS IDENTIFIED

5.1 Hardware

- Node MCU(ESP8266)
- L298N motor Driver
- GPS module
- Servo Motor
- ESP32 cam module
- DC gear motor
- Metal Detector sensor
- Jumper wire
- Flame Sensor
- Buzzer
- LCD Display
- I2C module
- DHT11 sensor
- 18650 3.7V 1200mAh Lithium-Ion Rechargeable Cell
- On/Off switch

5.2 Software Tools

- Arduino IDE
- Proteus 8™ software
- Easy EDA
- Blynk IoT software platform

6. RESULT AND DISCUSSION

- The Robot will be able to moves in all four directions: i.e. Right, Left, Front, Back
- The Robot will be able to detect mine ahead of it.
- This model robot provides less complex structure and reduces the cost to build a landmine detection robot.
- Since it provides the latitude and longitude positioning using the GPS module, it is easy to point out the exact position of the landmine in the form of co-ordinates.
- As the ESP32-CAM lacks a USB port, an Arduino board is required to upload the code. The ESP32's VCC and GND pins are wired to the ARDUINO board's VCC and GND pins. The ESP32's Tx and Rx are linked to the ARDUINO board's Rx and Tx. Through the L293D module, two DC motors are connected toESP32. The IO4, IO2, IO14, and IO15 pins of the ESP32 are connected to the module pins.

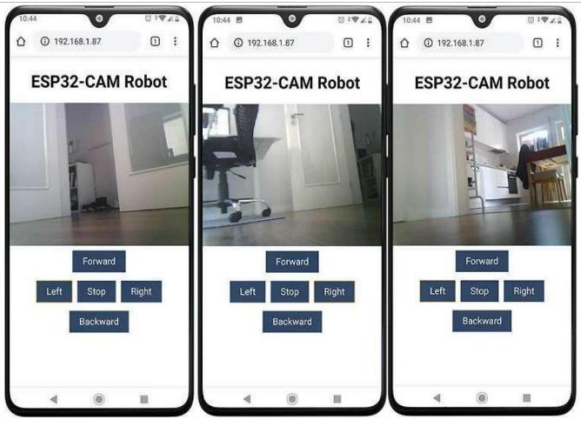

Fig -1: Result Of Surveillance robot

- The surveillance bot ESP32-CAM module has an ESP32-S processor, an OV2640 camera, and a microSD card slot. Images captured by the camera can be stored on a MicroSD card slot. The HTTP communication protocol will be utilized to receive video streaming from the OV2640 camera via a web browser in this case. As indicated in the image above, the webpage will also feature buttons to move the car in the Left, Right, Forward, and Reverse directions.
- The system uses a flame sensor to detect fire. The unique feature of this system is that it receives a push notification to your smartphone in the event of a fire at the connected location. That function is performed by the Blynk app. We can use this project mainly for military purpose to sense the fire.

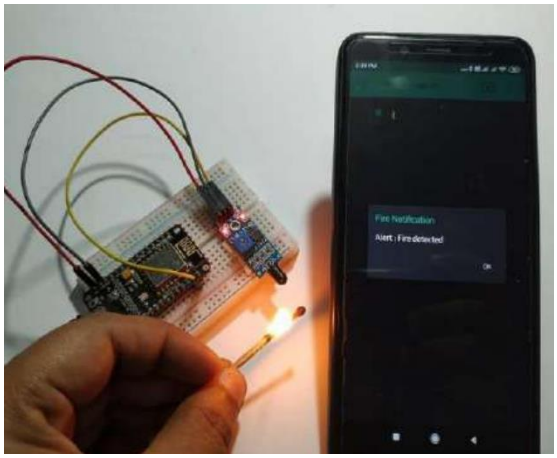

Fig -1: Result Of Fire Detection system

- The language used to build up the coding is C language. C language is a common language used in coding, computer programming, structured programming, and recursion. The system is first programmed to read the readings from the temperature and humidity sensor. Once it gets the reading from the sensor, it will start to evaluate the temperature value and the humidity level either the temperature or the humidity level are in the standard level. The expected result is shown in Table 1. All the temperature and humidity values are sent to the online database through the Blynk platform, so that all the data can be recorded and reviewed. The database used is on firebase which is a mobile and a web application development platform.

Table -1: Simulation result of coding

Temperature (℃)	Humidity (%)	Condition
10 < *T* < 40	35 < H < 90	Safe range
> 40	> 90	Alert (Both are HIGH)
> 40	< 35	Alert (Temp is HIGH & Humidity is LOW)
< 10	> 90	Alert (Temp is LOW & Humidity is HIGH)
< 10	< 35	Alert (Both are LOW)

- Figure 3 shows the LCD display with the temperature and humidity values displayed. The microcontroller interfaces the temperature and humidity sensor (DHT 11) and a relay which is used to control the load (humidifier). Table 2 shows the LCD display which corresponds to the system operations.

Fig -3: LCD readings

- From Fig. 4, as we know, the relative humidity level will decrease as the temperature increase. Therefore, when the temperature is higher than 40℃, the humidity level is lower than 35%, the relay will be set to HIGH in order to trigger the humidifier to increase the humidity of the environment. Meanwhile, when the temperature and the relative humidity level return back to standard range, the humidifier will be turned off.

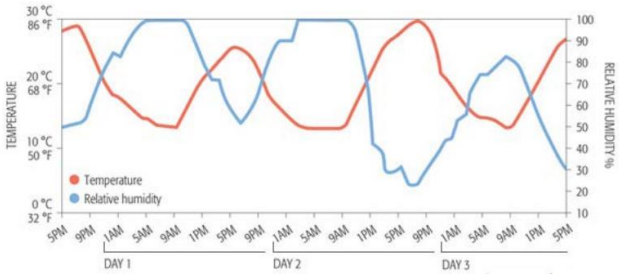

Fig -4: Graph of temperature against relative humidity

Table -2: LCD display which corresponds to operations

Temperature (℃)	Humidity (%)	Condition
10 < *T* < 40	35 < H < 90	Current temperature and humidity value
> 40	> 90	Temperature over 40℃ and humidity over 90%
> 40	< 35	Temperature over 40℃ and humidity below 35%
< 10	> 90	Temperature below 10℃ and humidity over 90%
< 10	< 35	Temperature below 10℃ and humidity below 35%

- The data from database is taken through the Blynk platform and displayed on the mobile application. This IoT function allows us to get the temperature and humidity level through wireless communication no matter where we are. Figure 5 shows the real-time database update of the application. The application will refresh itself every 3s.

Fig -5: Mobile application displays real-time value

7. CONCLUSIONS

1. In the current examination of the existing prototype of automatic landmine detection and sweeper robot has been presented and it can be made economically. So investments on landmine detection can be made more economical in the countries which are susceptible by landmines. This prototype delivers less complex structure and reduced the price to form a landmine detection robot. It can detect the landmines present under uneven ground surface and produces alarm to the user and successfully provides coordinates of landmine which can be then diffused safely, without the hazard of explosion

2. The surveillance robot will be designed to deliver a reasonable level of efficiency and simplicity, providing each user with a streamlined user experience. The surveillance robot is aimed at providing monitoring inclusive of vision, motion. The surveillance robot can be customized to fuse seamlessly to any warehouse, go down or multidwelling units. Based on modular designs and complete scalability, the surveillance robot is designed to be expandable and allow for future control upgrades, thus enhancing the accessibility of the user and providing a efficient way out of the tradition system

3. Thus the IoT based non-contact fire alarm security system was successfully developed and validated. The proposed scheme can be extended by using GSM(Global System Mobile) for long distance.

4. From the tests carried out, the measurement results of the DHT11 temperature sensor have a significant deviation and vary when compared to the reference, namely the digital thermometer. Through the indoor temperature measurement monitoring system, we can see information about temperature quality by looking at the information on the interface that has been designed using the Visual Basic application. The results of the data obtained by the DHT11 temperature sensor can be accessed anywhere online because the data system is stored automatically, namely using the Firebase database which stores real time.

8. FUTURE SCOPE

1. Certain places are only for gathering information and monitoring; thus, this surveillance car bot can surely be used; with advanced upgrades, we can provide data instantly and carry out military action as needed.
2. Current detection unit is only able to detect metal in a range of 10 cm but replacing with large circumference electromagnet coil can increase the depth of detection.
3. In case of plastic landmine detection, the detector can be replaced by ground penetrating radar or other detection mechanism.
4. Wheels size should be increased to remove the landmine from the actual mine fields. Shock absorbers can be installed and adjust wheel unit, so that it can run on any uneven surfaces field.
5. Obstacle detection sensor can be installed to avoid collision of robot with object which are coming in front of it.

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REFERENCES

1. Gaurav Golatkar, Prathmesh Ambekar, PrashantJadhav, Rohan Jadhav, Prajakta Borole. ‘Border Surveillance Using IpCamera’. In ‘IOSR Journal of Engineering (IOSRJEN)’ 2018.

2. Bharath J. ‘Automatic land mine detection and sweeper robot using microcontroller’. In ‘International journal of Mechanical Engineering and Robotics Research’

3. Jaradat M A, Bani Salim M N and Awad F H (2012), “Autonomous Navigation Robot for Landmine Detection Applications”, 8th International Symposium on Mechatronics and its Applications (ISMA), April, pp. 1-5.

4. Breejen E. D. et al 2003–2012 In Proceedings of 3rd International Conference on Forest Fire Research and 14thConference on Fire and Forest Meteorology (Luso, Portugal) Autonomous forest fire detection 16-20.

5. Singh, D., Sharma, N., Gupta, M. and Sharma, S. 2017. Development of system for early fire detection using Arduino UNO. International Journal of Engineering Science 10857–10860.

6. Ashish U. Bokade ; V. R. Ratnaparkhe , "Video robot control using smartphone and Raspberry pi", 24 November 2016 International Conference on Communication and Signal Processing (ICCSP), Melmaruvathur, India.

7. S Meghana ; Teja V Nikhil ; Raghuveer Murali ; S Sanjana ; R Vidhya ; Khurram J Mohammad presented "Design and implementation of Surveillance Robot for outdoor security" published on 15 January in 2017 2nd IEEE International Conference on Recent Trends in Electronics , Information & Communication Technology (RTEICT

8. Kim M., Kang K.C., Lee H. Formal Verification ofRobot Movements- a Case Study on Home Service Robot SHR100. In the Proceedings of the IEEE International Conference on Robotics and Automation (ICRA), 4739-4744p, 2005.

9. Loukianov A.A., Kimura H, Sugisaka M. Implementing distributed control system forintelligent mobile robot. 8th InternationalSymposium on Artificial Life and Robotics, Oita, Japan, January 24–26 2003

10. Global Journal for Innovative Research in Science and Technology (IJIRST)- Volume 1-May 2015' the Real Time Temperature Sensing utilizing Raspberry Pi

11. Khin KyawtKyawt Khaing & May Thin Khine, "IoT based Temperature, Movement and Light Monitoring System for Smart Building", MURC 2019, 24th - 25th June 2019, Yangon.

12. Roy, A.; Das, P.; and Das, R. (2017). Temperature and humidity monitoring system for storage rooms of industries. Proceedings of the International Conference on Computing and Communication Technologies for Smart Nation. Gurgaon, India, 99-103.

13. Karim, A.; Hassan, M.Z.; Akanda, M.M.; and Mallik, A. (2018). Monitoring food storage humidity and temperature data using IoT. MOJ Food Processing and Technology, 6(4), 400-404.

BIOGRAPHIES

Prof. Samrat Thorat is currently working as Assistant Professor in the department of Electronics and Telecommunication at GCOE, Yavatmal. He has a total 16-year experience in academics.

Gopal Dhanokar pursuing his B.Tech. degree from GCOE, Yavatmal. His areas of interest include Electronics, Simulation of electronic circuits, artificial intelligence and IOT based designs and applications.