An Employing Embedded Weather System for Self-driving Vehicles

Sahar Y. Mohammed[1] and Hamsa M. Ahmed[2][a]
[1]Computer Science Department, Al-Maarif University College, Iraq
[2]College of Computer and Information Technology, Computer Sciences Department, University of Anbar, Iraq

Keywords: Weather Station, Temperature, Self-driving Cars, Semi Self-driving Cars.

Abstract: Throughout daily life, control of the atmosphere plays a significant part and includes understanding the atmosphere environment. This system is a compact, low-cost weather data collection device that allows data to be collected, processed, and transmitted. The proposal for a smart weather station is a weather reporting system over the local networking. Weather station system is a hardware and software program that reads the status of the weather from the real-time temperature and humidity, which is an IoT that is a wirelessly connected. The client can directly access via local IP from any device connected in the same local network. It also shows the result on the front web application, as well as supports API routes. A weather station is also a tool that uses two sensors to collect weather and environment-related data. That means we need a weather station to make weather forecasts and collect weather-related data. Climate influences the actions of the car. The efficiency of vehicles, surface traction, and road structures raise the likelihood of crashes. While automated vehicles (AVs) are already on the road, in adverse conditions, they do not function very well. High temperature leads to the driver losing control of the vehicle and a crash.

1 INTRODUCTION

Nearly 100,000 fatalities each year were triggered by tropical weather. Most of these fatalities arise in areas system. Sensors in the base of operations. Consequently, the users have been provided the approximate weather details. (T. M. Bumbary et al., 2017). Monitoring the atmosphere can help to monitor different climate practices, including air temperature (T. Sung et al., 2014). There are several examples of the significance of al-ecological forecasting. In order to sustain strong crop growth and to ensure a healthy working atmosphere in the industry, environmental conditions must be tracked, etc. Owing to technological progress, the way to read environmental parameters has become easier than in recent days. (A. Sharma et al., 2016). By automatically activating such behaviour and monitoring the other equipment depending on the controlled values of temperature and humidity, this program may be applied to an automation network in your house. The real-time weather forecasting network is a valuable resource for tracking agricultural climatic factors, as an excellent knowledge of the local environmental environment allows many agricultural problems to be solved (S. Tenzin at al., 2017). Thanks to its low prices, high accuracy, and simple user experience with relatively small maintenance costs, the proposed device is handy (H. Saini et al, 2016).

In varying environmental environments and various periods of days, the performance of individual sensors shifts drastically. A LIDAR is very well performing under bright circumstances, but its sensitivity in rainy or snowy environments dramatically decreases. To render autonomous vehicles internationally appropriate in any nation and throughout each region throughout addition to operating with the same accuracy during the day, a lot of work and development needs to be performed here. Different climates have seen their results in the same location. A trained model will be consistent quite differently with others in every form of environment picture. There has been a lot of work and. (S. Bag. 2017). Many obstacles for automated vehicles in these areas include poor weather, especially because the general lack of road maintenance often demands improved danger identification, such as potholes, if

[a] https://orcid.org/0000-0002-5911-9682

speeds advised must be sustained, in particular (J. P. Sipani, et al., 2017). As shown in Figure 1, to ensure safe road and efficient driving, Self-Driving Vehicles to operate rainy or foggy, there will be a speed limit so that the vehicle does not run at over speed. To detect lane in bad weather or at night. (M. Daily et al., 2017).

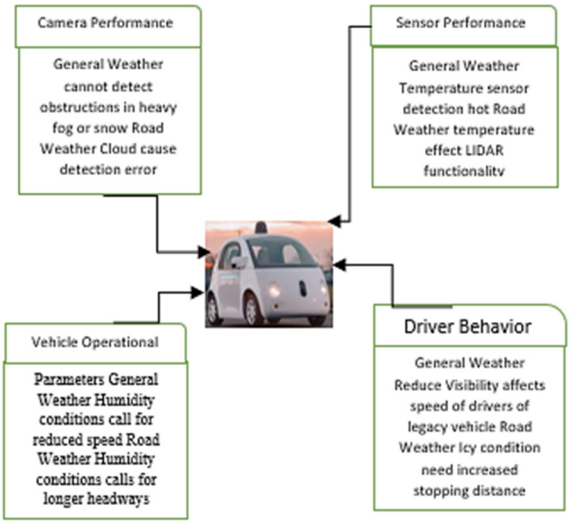

Figure 1: The relationship of self-driving cars with weather.

2 RELATED WORK

Although auto-driving cars need all the same embedded systems as your car today, other methods are much more important, critical for driving self-driving vehicles. Self-driving cars need all the technologies to make them completely aware of their surroundings and able to respond to environmental changes. The best reactions to villagers, other vehicles on the road, road obstructions, and other road hazards are essential for these automobiles. You will have to take account of environmental changes. For example, a self-driving car needs to know precisely what it takes to drive in this area if a sudden rainstorm or snowstorm occurs.

Dlnya Abdul had Aziz. 2018, illustrated the stable, friendly, and structured design of control systems with low-cost constraints. Due to its implementation in various fields, the project charms the (IoT) features in particular as a weather monitoring device to match navigation; Selecting transport routes, such as sailing, riding or flying, and planting the seed in farms under specific conditions, this work proved a sensible decision to implant the device in the agricultural fields.

Greco, Luca et al., 2018, designed a new microcontroller pick. The design of the device involves a secret aim of achieving a low-power consumable solution.

In addition to all remaining sensors, the microcontroller will consume too little power consumption. Sensor data is typically obtained as integer values, representing the parameter value of the setting. Sensor data is generally collected as integer values, representing the parameter value of the environment. For consumers to grasp, it will be in a graphical image. The details hosting on the own site page are more expensive and must be leased. To-the expense of the program. This weather station provides many benefits, including high precision, high reliability, easy maintenance, low power consumption, easy to extend, and remote monitoring in real-time. The device is simple to construct, compact, cost-effective, energy-effective, and dependable. The hardware architecture and data collection methods were illustrated-data of 4 months with variability altitude and timing of weather parameters.

M. Nsabagwa, M. Byamukama, E. Kondela, and J. S. Otim, 2018, proposed an automatic weather stations are important for the management of weather information because they provide accurate and timely data, however, if AWSs are inexpensive or not robust, it is difficult to achieve timeliness and precision. Because of our assessment in relation to the key non-functional categories i.e., this paper has been presented. Project attributes and constraints on efficiency. There are several prototype issues that need to be improved to get an affordable and sturdy AWS. There are several prototype issues that need to be/ improved in order to achieve an affordable and robust AWS. Power consumption. The prototype can minimize power consumption by flipping the gateway, The Pi Raspberry. The design of the power supply is important for battery-powered AWS components such as sensor nodes and microcontrollers with low power gateways. Transmission of data. The first-generation AWS prototype uses raspbian, an operating system similar to that of Linux. A number of communication devices are supported at the gateway. Environment parameters. The first-generation AWS prototype lacks rainfall measurements, which are particularly important for East Africa. First-generation AWS prototype is missing. Reliability. The correlations between temperature data were non-linear, particularly for July. This was due to the fact that the AWS prototype temperature sensor was not enclosed in the radiation shield, which caused the sensor to be heated by direct sunlight and increased the reading values.

3 PROPOSED SYSTEM

Using the data cable to connect the Arduino Uno board to the CPU. The breadboard is fitted with a DHT 11 temperature and humidity sensor. The sensor is again attached by the serial communication cables to the Arduino Uno board. Later, the correct software is imported into Arduino Software and the humidity and temperature measurements are displayed in a serial monitor. Arduino is the weather station's brain, which gathers several data from sensor DH11. This can calculate temperature and humidity from the climate, as its name implies. The planned weather station project is built around and process and view them on the computer by using the web-based Interface of the weather station to track data in real-time. Users will view data anytime in real-time, the intended outcome of this effort. This ensures that consumers will view details in real-time if they decide to learn what the temperature is. Then there are real-time updates that allow users to schedule the day. Awareness of such alarms that help prevent emergencies. All modules have been planned, and all components have been assembled. The growing module has successfully been checked (see figures 2, 3, and 4). In a safe setting, the sensor readings were effectively retrieved. More experiments in environments more similar to real weather conditions are therefore needed.

3.1 Code Mechanism

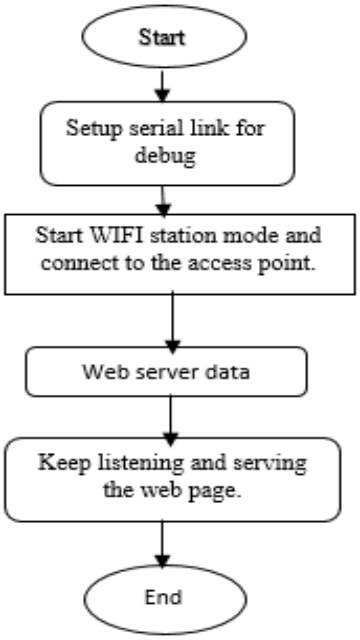

Figure 2: Code Mechanism.

The ESP8266 functions like an Access Point. We first create a hotspot Wi-Fi link system (Access Point), make web server, and handled it.

Figure 3: Connecting weather station components.

Setting up ESP8266 as an AP with the following commands as a password using the Custom SSID (WIFI AS) command.

```
WiFi.begin("weatherap", "12345678");
Serial.print("Connecting");
while (WiFi.status() != WL_CONNECTED)
{
  delay(500);
  Serial.print(".");
}
Serial.println();
Serial.print("Connected, IP address: ");
```

Figure 4: WI-FI station mode and connect to the access point.

As shown in figure 5, the centralized SDN controller is responsible for “slice”. The infrastructure include all physical network that consist some parts: “RAN nodes”, devices, “transport network”, and “storage”, then, connecting all the components to each sensor in order to a breadboard and the connected jumper wires.

```
server.on("/",[](){server.send_P(200,"text/html",HOME_PAGE);});/
server.on("/gettemperature", getTemperature);
server.on("/gethumidity", getHumidity);
```

Figure 5: Web -server data.

3.2 User Interaction with Architecture

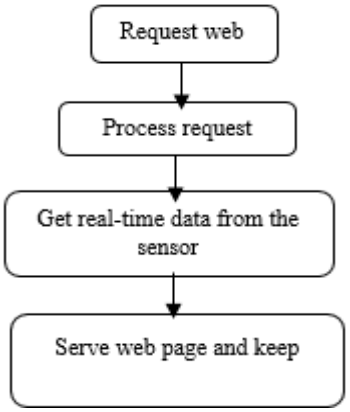

Figure 6: User Interaction architecture.

Figure 6 shows that the when take mobile and Turn on Wi-Fi and in Wi-Fi configuration Search for hot spot, and will find the hot-spot "ESP6822" Webserver" with password provided in the software. Open a web browser and enter the dynamic ip address after connecting to the ESP hotspot. The DHT11 sensor display.

4 SYSTEM DESIGN

This paper introduces a weather station model based on a microcontroller and a sensor. The system is designed to be scalable and easy to set up and extend. It is based on a powerful microcontroller (NodeMcu v3 ESP8266) that manages the whole system and sensor (DH11) for temperature and humidity (see figures 7. For the observation and measurement of the environment or the location.

4.1 NodeMCU V3 ESP8266

The ESP8266 contains a Wi-Fi transceiver. It not only binds to and communicates with a Wi-Fi network, but it even creates a system itself. There are many microcontroller modules on the market, but the blades are produced with minimal equipment as low as practicable.

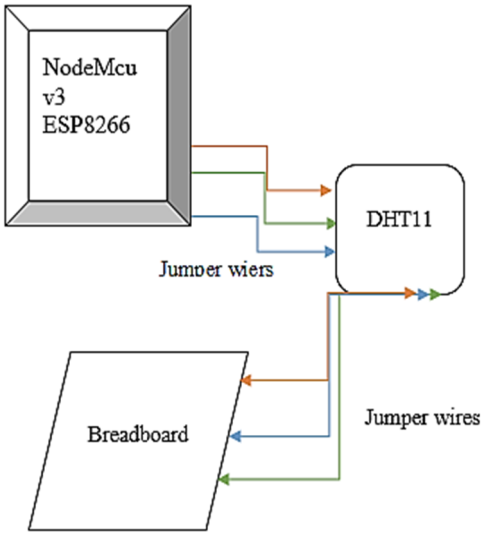

Figure 7: System design.

As in the module ESP6288, which only has one analog signal (D. A. Aziz, 2018); (L. Greco et al., 2016). NodeMCU is an open-source IoT program operated by the ESP8266 Wi-Fi chip-based network. Version 3 of NodeMCU is supported by an ESP-11E (ESP8266MOD), a simple-to-use USB adapter built on the CH340 g module and a micro USB connector, with an analog and digital button. Arduino has recently started to build a new microcontroller. This war came about when a new ESP8266 Node MCU module was developed and popularly recognized. As shown in figure 8, the module is independent of the AVR processors and partially similar to the Arduino MCU (A. Al Dahoud and M. Fezari, 2018).

Figure 8: NodeMcu v3 ESP8266 (A. Al Dahoud and M. Fezari, 2018).

4.2 Jumper Wires

Such quality jumper wires have a total of six (150 mm) and a 'line' of 40 (4 bits in each of ten rainbow colors); on one end of them, It has 0.1 'male header contacts and 0.1' contacts on the male header on the other. The best thing is they are equipped with a 40-pin belt cord. The ribbon wires may be taken off to create an independent jumper or held together to make entirely connected wires. Such male to female jumpers is robotic and embedded system designs. Electrical wiring is the electrical construction in a system of the fence and the associated devices, such as buttons, boards, and connectors. Cables are subject to construction and implementation protection requirements. Arduino Uno and breadboards have three essential forms of jumper wires (R. Vijay et al., 2017); (M. Kashyap et al., 2018), see figure 9:

- Male to male jumper wires.
- Male to female jumper wires.
- Female to female jumper wires

Figure 9: Jumper Wires (M. Kashyap et al., 2018)

Jumpers can be omitted or connected to other device output solutions, including on/off switches. A jumper is constructed of electricity transmitting materials and is coated with a non-conducting membrane to avoid unintended short circuits. The key benefit of the jumper is its one-time configuration, rendering it less vulnerable than firmware to manipulation or power loss. (K. Chidhambaram et al., 2019).

4.3 DHT11

DHT11 is an inexpensive, moisture and temperature-sensitive sensor. We attached the DHT11 sensor to the Arduino's digital pin seven during this phase.There are three pins from Vcc, Data, and NC (not linked) and GND from left to right. There are primarily three buttons. DH11 is Connects the soil on Arduino and Vcc soil to Arduino 5V production (E. P. Uagbae, et al., 2018). DHT11 is a low-cost wireless system for temperature control and air humidity calculation (M. Katyal et al., 2018), see figure 10.

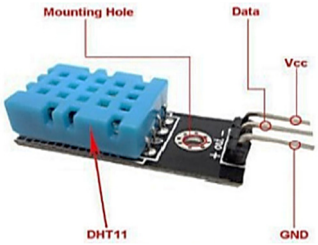

Figure 10: DHT11 (M. Katyal et al., 2018).

4.4 Breadboard

As depicts in figure 11, the breadboard had been a useful tool for basic electronic experiments. The breadboard can still survive for another ten years. Nonetheless, a complicated wiring job can be a nightmare during the trial except for an expert person. Requires not only time to wires, but even a non-logical error may arise where a loose connection occurs between the jump.

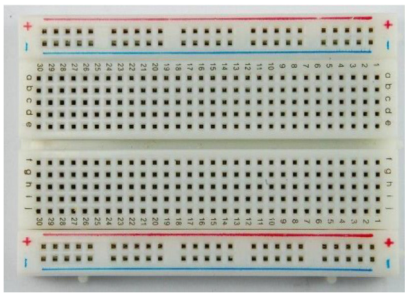

Figure 11: Breadboard.

5 EXPERIMENTAL RESULT AND DISCUSSION

A full system check was carried out prior to the start of the experiment to ensure that the transmitter and receiver system did not encounter a minimal error. Every sensor has successfully been tested. The experiment takes place by the receiver system connected to a device see figure 12. The results are the minimal error in sensor readings. The Interface was installed, developed and installed to view the data.

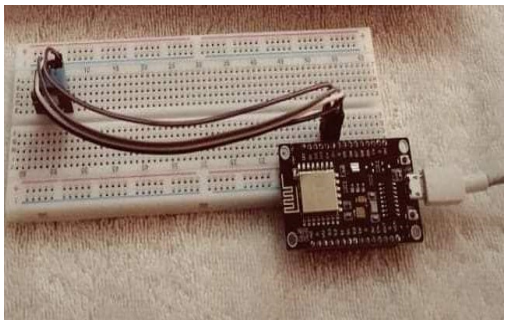

Figure 12: Hardware implementation.

Within the current weather method, realistic enhanced data reliability outcomes are calculated. The findings produced while the station operated twice a day (7:00 a.m. to 4:00 p.m.) in six reading periods (temp, hum) from the broadcaster node in Ramadi Iraq between 1-April-2020 and 7 -April-2020 were seen in table1:

Table 1: Weather data from the proposed weather station.

No.	D_State	Time	Sat	Sun	Mon	Wed	Tus	Fri	Accuracy
1.	Humidity	7:00 Am 4:00 Am	17 °C	20 °C	18 °C	17 °C	13 °C	09 °C	100 %
2.	Temperature	7:00 Am 4:00 Am	63 °C	39 °C	60 °C	23 °C	34 °C	19 °C	100 %

The difference between reading from Table 1 (www.weather.com) and the reading from Table 2 (proposed weather station) is minimum. The difference in temperature is about 2 °C, the difference in humidity is about 3%, were seen in table2:

Table 2: Weather data from the weather station.

No.	D_State	Time	Sat	Sun	Mon	Wed	Tus	Fri	Accuracy
1.	Humidity	7:00 Am 4:00 Am	18 oC	17 oC	16 oC	17 oC	13 oC	10 oC	100 %
2.	Temperature	7:00 Am 4:00 Am	64 oC	37 oC	61 oC	23 oC	34 oC	19 oC	100 %

A comparison between weather measurements from air stations and weather.com, the results are matched. Weather Station Accuracy 95.2 %. After connecting the weather station to the wireless access point, we use a networking tool to get the IP address assigned to it by the access point DHCP service and use this IP address to access the weather station's web-based GUI for real-time data monitoring. And we can use the same IP address with postfix '/temperature' or '/humidity' and implement these as an API to use with other apps that utilize our weather station's service. All modules have been planned, and all components have been assembled. Each module had been successfully tested. The sensor readings were recovered effectively in a safe environment and the results are returned to the user for viewing through a web page. We then plotted graphical charts.

Using the data that offered a nice weather pattern analytical view based on sensor readings. And the evaluation process was completed. This study was carried out in a controlled fashion. Curve of performance of the findings obtained in the experiments are below (see figures 13 and 14).

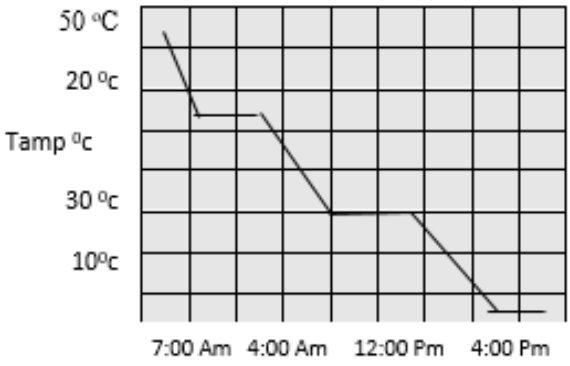

Figure 13: Temperature.

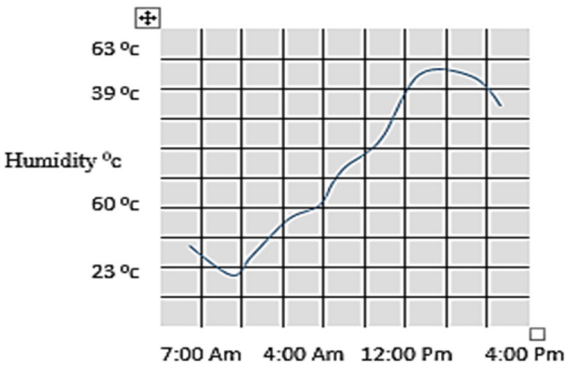

Figure 14: Humidity.

6 CONCLUSION AND FUTURE SCOPE

This prototype offers a practical and low-cost approach for continuous monitoring. Fast repair, low power usage, natural expanding, and remote con troll in real-time. The only drawback of this sensor is that you can get current data from it every second or two seconds. But, despite its efficiency and size, you can't talk about it. As expected, one of the potential fields of mobile apps is consistent with some core data input. The unique feature to be included as an idea in this device is that it can be used for any vital environments or local area rather than. Costly weather stations that can work on a full scale. Such operate on public wireless networks to a limited degree. The machine is built for (humidity, temperature, air pressure, wind speed) direction, and in the real-time calculation of the current values. The algorithm for short- term weather forecasting can be applied based on the juxtaposition of historical data and actual calculated information, established methods of weather forecasting, and the determination of the relationship between produced meteorological quantities. The device may be used to measure temperature and humidity in space or business. People with asthma, pregnancy, old age need to have different temperature and humidity. The heat and thickness of the goal region should be experienced, not in a town or village.

Even when self-driving vehicles also optimistically forecast temperatures at entry, the development of the system is used in warm environments with the first hardware. Nonetheless, sunny weather conditions may hinder the implementation of autonomous vehicles, or create issues if it is deployed too rapidly in cold weather. In the near term, some of these Motor vehicles will secretly calculate, track and distribute direct road and air condition (pressure, temperature) and indirect (e.g., wiper, anti-locking, and vehicle stability control system status) measurement and distribution. Weather conditions play a significant role in affecting self-driving cars, which are still under development with advanced digital sensors and cameras to read weather changes, such as temperature, precipitation, and fog. Soon, we will work to develop this weather monitoring to stop the self-driving car driving in the event of high heat or humidity to avoid accidents. Bad weather is an unusual natural occurrence. But a defensive response may be performed to alert citizens about adverse weather hazards on roads or deteriorate the environment. Yet drivers may be admonished by

utilizing the weather station program on environment and road conditions in real-time.

In the future, we can add a number of different Sensors such as earthquakes detection sensor, rain Rate sensor, light sensor and send data to the server and to the cloud. User will communicate with the device using the app.in the future, we will work to develop this weather monitoring to stop the self-driving car. Driving in the event of high heat or humidity to avoid accidents.

ACKNOWLEDGEMENTS

First of all, praise and our appreciation to God who facilitated this research. We would like to express our appreciation and thank you very much for your help. Ali Alshekarchee and Dr. Khattab M. Ali Alheeti speech to teach values and patience

REFERENCES

T. M. Bumbary, "Utilizing a network of wireless weather stations to forecast weather in developing countries," ISEC 2017 - Proc. 7th IEEE Integr. STEM Educ. Conf., vol. 00, no. c, pp. 109–111, 2017, doi: 10.1109/ISECon.2017.7910223.

W. T. Sung, J. H. Chen, C. L. Hsiao, and J. S. Lin, "Multi-sensors data fusion based on arduino board and XBee module technology," Proc. - 2014 Int. Symp. Comput. Consum. Control. IS3C 2014, pp. 422–425, 2014, doi: 10.1109/IS3C.2014.117.

A. Sharma, G. Tiwari, and D. Singh, "Low cost Solution for Temperature and Humidity monitoring and control System using Touch Screen Technology," vol. 2, no. 1, pp. 10–14, 2016.

C. S. Real-time, "Environmental Monitoring System Using IoT and Environmental Monitoring System Using IoT and Cloud Service at Real-Time," 2019.

S. Tenzin, S. Siyang, T. Pobkrut, and T. Kerdcharoen, "Low cost weather station for climate-smart agriculture," 2017 9th Int. Conf. Knowl. Smart Technol. Crunching Inf. Everything, KST 2017, pp. 172–177, 2017, doi: 10.1109/KST.2017.7886085.

H. Saini, A. Thakur, S. Ahuja, N. Sabharwal, and N. Kumar, "Arduino based automatic wireless weather station with remote graphical application and alerts," 3rd Int. Conf. Signal Process. Integr. Networks, SPIN 2016, pp. 605–609, 2016, doi: 10.1109/SPIN.2016.7566768

S. Bag, "Deep Learning Localization for Self-driving Cars," ProQuest Diss. Theses, p. 104, 2017, [Online]. Available: https://search.proquest.com/docview/1880508671?accountid=49007%0Ahttp://www.yidu.edu.cn/educhina/educhina.do?artifact=&svalue=Deep+Learning+Localization+for+Self

J. P. Sipani, R. H. Patel, T. Upadhyaya, and V. T. Patel, "Temperature & Humidity Monitoring & Control System Based on Arduino and Sim900a Gsm Shield," Int. J. Electr. Electron. Data Commun., vol. 5, no. 11, pp. 2320–2084, 2017, [Online]. Available:ACM Int. Conf. Proceeding Ser., pp. 3–6, 2020, doi: 10.1145/3377049.3377121. driving+Cars&stype=2&s=on%0Ahttp://sfx.cceu.org.cn:3410/bisu? url_ver=Z39.88-2004&rft_val_fmt=.

M. Daily, S. Medasani, R. Behringer, and M. Trivedi, "Self-Driving Cars," Computer (Long. Beach. Calif)., vol. 50, no. 12, pp. 18–23, 2017, doi: 10.1109/MC.2017.4451204.

R. Chowdhury, Z. Islam, S. D. Rozario, Z. Mohammad, and M. I. Ema, "Automated self driving car following lane with emergency braking system,"

D. A. Aziz, "Webserver Based Smart Monitoring System Using ESP8266 Node MCU Module," Int. J. Sci. Eng. Res., vol. 9, no. 6, pp. 801–808, 2018.

L. Greco, P. Ritrovato, T. Tiropanis, and F. Xhafa, "IoT disasters," Concurr. Comput. , vol. 30, no. 21, pp. 1–9, 2018, doi: 10.1002/cpe.4789.

A. Al Dahoud and M. Fezari, "NodeMCU V3 For Fast IoT Application Development," Notes, no. October, p. 5, 2018.

R. Vijay, T. Sainag, and V. Krishna, "Smart Home Wireless Automation Technology using Arduino based on IOT 1," vol. 8, pp. 38–45, 2017, [Online]. Available: http://www.iject.org/vol8/issue4/7-rampeesa-vijay.pdf.

M. Kashyap, V. Sharma, and N. Gupta, "Taking MQTT and NodeMcu to IOT: Communication in Internet of Things," Procedia Comput. Sci., vol. 132, no. Iccids, pp. 1611–1618, 2018, doi: 10.1016/j.procs.2018.05.126.

K. Chidhambaram, S. A. Kumar, T. M. Kumar, and D. Dhanasekar, "Design Analysis of Land Surveying Robot Using Arduino Uno," no. May, pp. 6208–6214, 2019.

E. P. Uagbae, V. Eshiet, and U. Godwin, "Arduino-Based Weather Monitoring System Arduino-Based Weather Monitoring System," no. February, pp. 835–846, 2018.

M. Katyal, Amber; Yadav, Ravi; Pandey, "Wireless Arduino Based Weather Station," Int. J. Eng. Sci. Res. Technol., vol. 5, no. 4, pp. 238–240, 2019, doi: 10.5281/zenodo.2636956.