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City Guard: Raspberry Pi 4 Driven Accident Surveillance System with MEMS, GPS, GSM, and Integrated Applications

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ABSTRACT
This study is focused on the concept of the Internet of Things (IoT)-based smart city model on Rasp- berry Pi. It assesses the design and implementation of a smart city based on the Internet of Thingsusing Raspberry Pi. The main aim is to develop an urban IoT system that will aid in the realizationof a smart city while also resolving domestic issues using Raspberry Pi. Raspberry Pi is an essential component of the smart city model’s implemented system. The concept of the IoT helps analyze the functions used to define the functions of Raspberry Pi. By considering the developing country such as India, IoT plays an essential role in building a smart city model. In this work, the different low-cost operations have been analyzed based on the functions of Raspberry Pi for the smart city model.

KEYWORDS
Internet of things; Low-costoperation; Raspberry Pi; Smart city model

I.INTRODUCTION

This study is used to evaluate the design and implemen-tation of IoT on Raspberry Pi for different smart city models. Smart cities use information and communica- tion technologies to be more intelligent and efficient in their resource use, resulting in cost and energy savings. Itcontributesto better service deliveryand qualityof life byreducing the innovationof different cities. A smart city isan urban area with various types of electronic data collec-tion sensors to provide information. It plays an essentialrole in evaluating the functions of the Internet of things for the different parameters of the system. The compo- nents such as automation, the system of car parking, andmanaging the level of water are examples of such systems.Different block diagrams are used to describe the designof IoT.

The increasing demand for vehicles is causing traffic to increase daily. Therefore, there is a need for improved transportation since as demand grows, so does the likelihood of auto accidents. One of the main reasons people die is car accidents. If people are unable to receive help when they need it, it will have serious consequences. The fatality rate in our nation could be significantly attributed to a subpar emergency incident. Beyond machine-to-machine interactions, the Internet of Things (IoT) provides enhanced connectivity of systems, devices, and services across a variety of protocols, domains, and applications. Almost every automation domain uses these embedded devices, including smart objects, in conjunction with one another.abling advanced applications like a Smart Grid. More-over, the term things in the IoT refers to a wide variety of devices such as heart monitoring implants, biochip transponders on farm animals, electric clams in coastal waters, automobiles with built-in sensors, or field opera-tion devices that assist fire-fighters in search and rescue.Current market examples include thermostat systems and washer/dryers that utilize Wi-Fi for remote monitor-ing. The salient features of the work are as follows:

- We have discussed the IoT technology that helpsdesign the smart city model based on the functionsof Raspberry

Pi. The study evaluates different appli- cations of Raspberry Pi in the Internet of things. The set of open and standardized protocols is significantlysmaller than the design options for IoT systems. Fur-thermore, the enabling technologies have matured to the point where they can implement IoT solutions andservices.

- Comprehensive analysis on the smart city with IoT and urban city without IoT is done based on IoT using Raspberry PI. Four types of evaluations param-eters have been used to evaluate the Raspberry Pi techniques.
- Further, using the sensor unit, around the hospitalis supposed to be tracked system while the Global Positioning System tracks the location during major accidents. Additionally, the authors suggested trackingthe nearest hospital, which could be accomplished inthe near future through the use of a location map that

includes more detailed information about the nearest hospital and can be passed to the ambulance.

- The study's conclusion is used to implement the IoT-based design on Raspberry Pi for different smart city models. Modified architecture and specifications are used to evaluate the functions of Raspberry Pi for thesmart city model.

The paper's different sections are organized as Section 2elaborates the related works. Section 3 discusses the pro-posed technique based on Raspberry Pi for smart cities using IoT. Section 4 enlitghtens the merits and demeritsbased on the critical analysis of the functions of Rasp- berry Pi for the smart city model. The work is concludedfollowed with future directions in Section 5.

II. METHODOLOGY

In an alternate shrewd city, the web of things assumes a significant part. The savvy city is a creating market that will assume a fundamental part in future foundation. Since a brilliant city means to utilize energy and power proficiently, giving a helpful and financially sound infras-tructure for cultural prosperity, the significance of IoT innovations is featured for the shrewd model. The IoT cooperates with the standards to carry out appropriate applications' capabilities in the savvy city model. Tohe et al. [1] recommended the activities of the recurrence access the organization to empower the various degrees of data. The adaption of new innovations helps in breaking down the cycle to work with the applications for a savvy city. The production of different locales gives an advantage in the casing work of various work processes. There are numerous areas, and basic administrations are displayed in the table utilized for IoT advancements in a savvy city. The job of IoT in shrewd urban communities as a rundown of IoT applications in various spaces is examined in Table 1.

The study used the function of Raspberry Pi because of itsuser-friendly features and cost-effectiveness; RaspberryPi was chosen as the system's processing unit. Accord- ing to Chaudhari *et al*., the concept of IoT evaluates the

Table 1: IoT applications in different domains

Domain	Use cases Smart Cities	Smart village

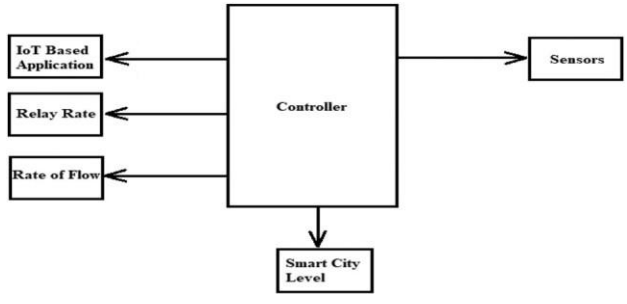

Figure 1: Block diagram of IoT design based on Microcontroller

function by developing the different parameters required for designing. Because of the rapid growth of the urban population, infrastructure and services are required to meet the needs of city residents [14]. There is a significantincrease in digital devices on this basis because all devicescan interconnect and communicate with one another viathe Internet.

A. Advantages and Disadvantages of Raspberry Pi in IOT

The concept of Raspberry Pi is low-cost operations that are used for designing the programable functions of a computer, which includes different sets of functions. Thecollection of General-Purpose Input-Output (GPIO) is used to control the Internet of Things' external device. The process of IoT is used in different devices that are running on the platform of Raspberry Pi (Figure 1). Thebelow diagram shows a separate device connected with the gateway on the IoT platform. The concept of Rasp- berry Pi consists of different advantages and disadvan- tages based on the implementation of IoT. The above- described advantages and disadvantages of the designof the internet of things [15] are used to evaluate the implementations of IoT for different smart cities [16]. ANon-Watertight Polygonal Surface Reconstruction tech-nique From Building Point Cloud via Connection and Data Fit is discussed in [17]. Table 2 shows the compari-son betweena smart city with IoT and Urban city withoutIoT.

B. PROPOSED ARCHITECTURE OF IOT DESIGNBASED ON RASPBERRY PI FOR SMART CITY

Smart Transport	Smart mobility, parking solution [2–4]	
Smart Building	Emergency warning of fire,	Earth Quack, HousingQuality, Building Security [5,6]
Smart Mobility [3,4]		
Smart Building [9]		

The given system consists of block diagrams used to describe the functions of the Internet of things. Three components are used in designing the system of imple- mentation. The first parameter is a smart parking system,the second parameter is smart applications of managing Waterand the third parameter is the initialization of a smart public garden. It consists of three different sensors

Smart Government	E-governance [7,8]	Smart Election [10]	
Smart Lifestyle	Pollution Control, E-health,	Smart Education [9,10]	Public Security [11–13]

Table 2: Comparison of Smart city with IoT vs Urban citywithout IoT

Smart City using IoT	Urban city without IoT
It is used to enhance the capability ofdifferent devices on trait of smart city	Consists of the stronger and quickerrate of processor
Functions of Operating System can beswitched easily	Contains long to set up
Consists of various components to implement the functions ofRaspberry Pi	More expensive
Multiple works at the same time	Evaluate the design for building smart city
Higher efficiency	Variety of different shields add thefunctionality of Raspberry Pi onIoT
Increase the rate of transmission in the Require complexity to connectinternet of things	with different sensors.
Increase rate of cost factor	Reduce the rate of operation

All the layers help in reducing the functions that arerequired for building the applications.

- Data Management Layer – The first layer in design- ing the smart city model is the data management layer.This layer is used to collect data on the perspectives of the process used in creating the city. In the contextof IoT, different applications are used to develop the functions of the network [23].

that are directly connected with Raspberry Pi as shown in Figure 1.

The given block diagram consists of three sensors that are connected for designing a smart city model. The dif-ferent rate of flow consists of different relay rates basedon the level of smart city applications. The architecture of IoT consists of different stages used for designing theRaspberry Pi in the smart city model. The four stages are a sensor, internet gateway, Datacenter, and the syn- thesis of IoT. The architecture of IoT consists of four layers to design the implementation of the smart city model [18–20]. According to Fan *et al*. [21], they are thedata management layer, application layer, network layer, and perception layer. Different layers in the proposed IoT architecture based on Raspberry Pi are shown in Figure 2.

- *Application Layer* – The second layer in designing the smart city model is the application layer. This layer is responsible for the distribution of the networkin terms of certain levels of the process. The factors help in analyzing the functions that are used for the enhancement of the system.
- *Network Layer* – The third layer of the IoT architec- ture is the network layer [24]. According to Cheng*et al.*

(2017), this layer is composed of different net- works and data transfer widely used for the applica- tions of the IoT. The other connected devices are usedto reduce the functions based on the efficiency of thesmart network.

- *Perception Layer* – The fourth layer of the IoT architec-ture is the perception layer. In this layer, the different characteristics of the process consist of some deviceson the framework of the process. There are various networks used in managing the applications of the system [25].

Table 3 describes the layers of IoT architecture onthe phase of the system [1,26]. In implementing the IoT, thenetworks are more accurate in identifying the function- ality of the process. Following are the few functions of IoT that are also used in designing the smart city model.

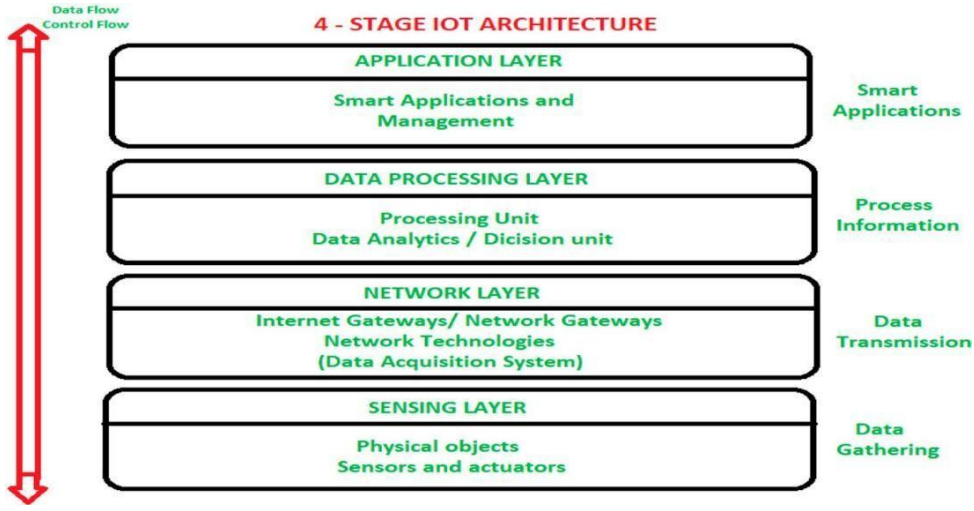

Figure 2: Different layers of IoT architecture with Raspberry Pi [22]

Table 3: Description of different layers in proposed architecture

Layers in IoT architecture	Description of the Layer in IoT architecture
Data management layer	Collects different data on the practices of the IoT architecture
Application layer	Distributing the functions in the process in the context of smart city
Network layer	Composed of different networks on the trait ofthe process.
Perception layer	The characteristics of the process evolve the information by implementing the system

The system's failure regenerates an issue on the release of different related information on the level of security.

C. Specifications of Raspberry Pi for Smart CityModel

The Raspberry Pi standard aids in the evaluation of functionalities when creating a smart city model. RPI, or raspberry pi, is a little, inexpensive card that is carried in the palm of the hand. It can function asa full-fledged computer in theconstruction of a smart city network. The different func-tions of the raspberry pi are used to evaluate the functionsbased on the system's practices. Other smart cities are evaluated in the domain of the Internet of things. There isan applicable range of process design and information onthe perspectives of the suitable maturity level of the smartcity applications. A considerable amount of functions aregenerated on a different effort which is applied by the process. The specifications of the network are helped in analyzing the process that is used in the Raspberry Pi sys-tem. Jaiswal *et al.* [27] illustrate the functions to providea broader action by demonstrating the company's inno- vation. It is concluded that there are possible approachesrequired to evaluate the information adopted by pro- viding fruitful parameters by initiating the company's policies.

The wide range of the functions helps generate the issues on the boundary of suitable estimation factors. The growth rate of the population causes a shortage by influencing the dimensions of the stakeholders. The iden-tification and the specification of the process consist of some factors that help in reducing the network. The esti-mation of the system criticizes the functions in terms ofpractical aspects of regulation. The identification of the problem is considered to be an essential issue for the range of performance. The high-level opportunities are used to reduce the description based on the approachof certain aspects. The functionality and the nature of water resources achieve the systems on the advancement

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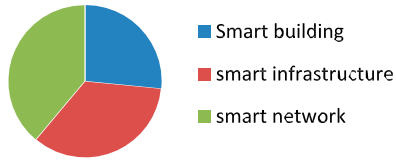

Figure 3: Segments used in building smart city model [31]

of the company required for utilization. The researchersof the study rationalize the processes. The study will pro-vide sustainability to the business and prepare them for sustainable development [28,29].

The concept of Raspberry Pi helps in evaluating the process on the trait of the system. The different IoT- based applications help in analyzing the functions that arewidely used for the smart city model. The evaluation of the process is critically used to determine the functions on the level of certain acquaintances. The separation of the process establishes the level of substances needed forthe expenses of the given functions. The smart city modelcontains different functions used in designing the processof Raspberry Pi.

Ageed *et al*. [30] provide a better understanding in termsof the factor of evaluation based on various skills forthe utilization of the process in the context of different parameters. The given graph shows the percentage of the different segments used to build a smart city model. Smart building, smart infrastructure, and the smart net- work are the three parts used to design the model based on IoT as shown in Figure 3.

III. RESULTS

Parameters used in evaluating phase of the smart city model [32] are shown in Figure 4.

The four parameters are comprised of four functions that help evaluate the smart city model [31].

- *Smart system of parking* – The first parameter of designing the system is smart parking functions. All three sensors help in detecting the functions which are used for implementing the smart city model. Sen-sors are used to see whether or not slots are availableand continuously update that information to the web server via the Raspberry Pi controller. By utilizing thistype of parking system, less time will be consumedin locating parking slots, which is very beneficial fordesigning the smart city.

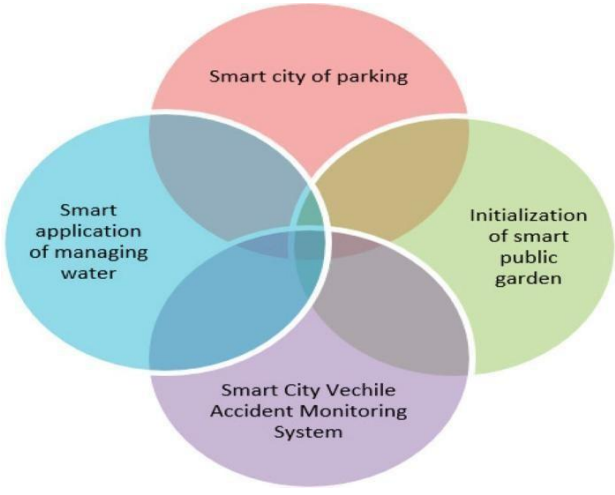

Figure 4: Parameters used in evaluating phase of smart citymodel [32]

- A clever use of water management – The second criterion is predicated on the use of clever water management. To monitor the water flow from each solenoid valve dispersed to each region, the water flow sensor is connected to the relay or tank. The user will be able to see how many litres of water that particular region uses. The Raspberry Pi

controller gives data about how much water is used in each location. Using this parameter, an Internet of Things system that helps minimise human contact with the most cutting-edge communication technologies is constructed. [32].

- *Initialization of smart public garden* – The third parameter is used to initialize the functions of smart public gardens in different smart cities. As per Shevale *et al*. [33], the initialization of a smart public garden is designed based on Raspberry Pi, which is used to operate and control the efficiency of the smart city model. In the management of public parks, there isa sensor that detects the path in various smart cities because of the rapid growth of the urban population; infrastructure and services are required to meet the needs of city residents. Smart cities manage resources effectively and efficiently.

- *Smart City Vechile Accident Monitoring System:* Motion sensor monitoring, ultrasonic sensor moni- toring, passive infra red (PIR) sensor monitoring andspeed sensor monitoring are being used for monitor- ing the vehicle accident in smart cities. Further, usingthe sensor unit, around the hospital is supposed to betracked system while the Global Positioning System tracks the location during major accidents. Moreover,the authors also suggested tracking the nearest hospi-tal, which can be done in near future using a locationmap with better information about the nearest hospi- tal and can be passed to the ambulance. The critical service and the sectors are used to utilize the functions required for designing the applications of IoT technology. In implementing the IoT, the networks are more accurate in identifying the functionality of the process. The IoT is used to relate the functions basedon relevant factors of the development process. The IoTauthorizes the use of the resources in the context of a smart city. The technology of IoT addresses the differ- ent concepts to generate the perspectives of the process.The different views of the Internet of things help analyzethe functions based on the Raspberry Pi controller. The estimated connection of the city in IoT [34] evaluates thesystem in different years, shown in Figure 5.

IV. DISCUSSION

Figure 5 shows the estimated rate of connection in IoT for different smart cities. In the year 2016, the calculatedrate is less as compared to that in the year 2020. In 2017,the pace in the internet of things was less than that of another year. Figure 6 shows the different years with theadditional rate of IoT-based design for a smart city model[22].

The Raspberry Pi's capabilities for the smart city model have been assessed using the Internet of Things framework. In the context of a smart city, the Raspberry Pi IoT design can serve as an internet gateway. The functionalities utilized to access the standards of comparable apps deployed in the network phase are enhanced by the Internet of Things-based smart city model. Despite its rapid evolution and affordable pricing, Raspberry Pi is still in its early phases of development.

IoT has enabled this procedure to be performed at a lowcost, with ease of access and flexibility of use. Monitor-ing, analysis, prediction and controversy are all featuresof IoT. Processing, and communication between devices,it is critical that all of our daily activities be automated

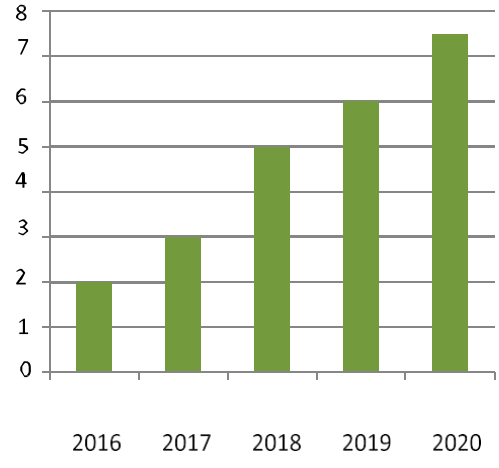

Figure 5: Estimated rate of connection in IoT for different smartncities at different years [35]

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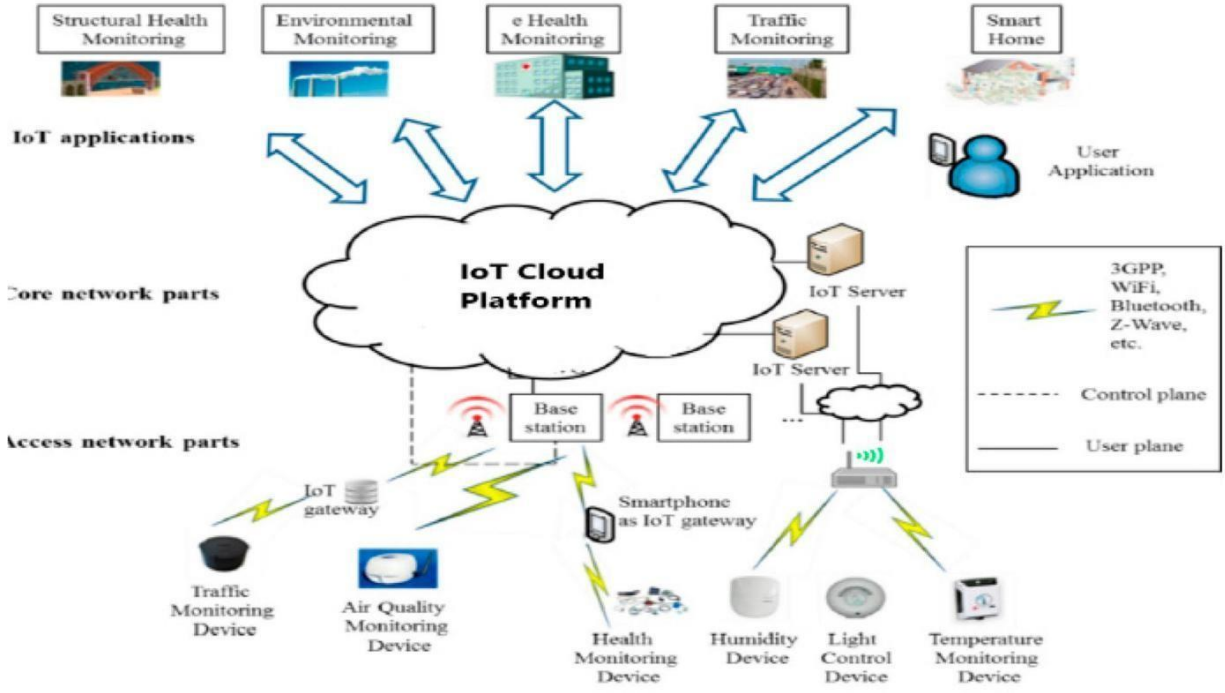

Figure 6: Rasberipi functions evaluate the network for IOT implementation [32]

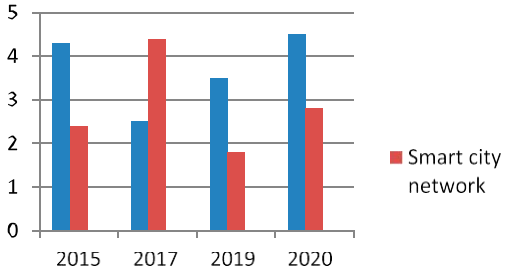

Figure 7: Global trend of IoT in building smart city network [36]

and linked simultaneously using Raspberry Pi. The globaltrend of IoT evaluates the functions for building smart city models. The smart city revenue consists of differentrates in different years, shown in Figure 7.

Figure 7 shows the different rates in the Internet of Thingstrend for building smart city networks. In 2015, the globalmovement of IoT and smart city networks was higher than that in 2020 [37]. To create a smart city model, IoTplays an exclusive role in the phase of the environment [38].

A.CONCLUSION

This paper proposes to help in reducing fatalities ema- nating from vehicular accidents by decreasing the emer-gency response time. With this new system, the time lagis reduced. Real-time accident occurrence and detection can save lives. In this work, we have presented an androidapplication based on accident occurrence and detection systems that augment data from sensors such as piezo- electric sensor, magnetic sensor, GPS, and power supply.Proposed models are based on the occurrence of a vehi-cle accident by monitoring the accelerometer's speed andsending a message to the registered number in our appli-cation when the vehicle crossed the threshold value. Theabove study concludes that IoT can monitor and detect regular smart city applications by sensing and controllingsmart city parameters, which will be more accurate, reli-able, and low cost than a yearly operating system. Further,using the sensor unit, around the hospital is supposed tobe tracked system while the Global Positioning System tracksthe location during major accidents. Moreover, theauthors also suggested tracking of the nearest hospital, which can be done in near future using a location map with better information about the nearest hospital and can be passed to the ambulance.

As a part of future work, we are finding whether the information will be delivered when the vehicle is locatedin rural areas and remote places. The project will be accurate and efficient by introducing a hall effect sensor.The overall processing load is still cheaper with low-costsystems, encouraging its porting on embedded systems with limited hardware resources. The solution will havea significant essential impact on reaching the message [38,39–44]**REFERENCES**

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