TRACK MONITORING SYSTEM ON INDIAN RAILWAYS USING IOT

Project report submitted in partial fulfillment of the requirement for the degree of Bachelor of Technology

in

Computer Science and Engineering/Information Technology

By

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to

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CERTIFICATE

I hereby declare that the work presented in this report entitled **"Track Monitoring System on Indian Railways Using IOT"** in partial fulfillment of the requirements for the award of the degree of **Bachelor of Technology** in **Computer Science and Engineering/Information Technology** submitted in the department of Computer Science & Engineering and Information Technology**,** Jaypee University of Information Technology Waknaghat is an authentic record of my own work carried out over a period from August 2018 to May 2019 under the supervision of **Dr. Shailendra Shukla**, Asst. Professor(SG), Department of Computer Science and IT.

The matter embodied in the report has not been submitted for the award of any other degree or diploma.

Vaibhav Gupta, 151204

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This is to certify that the above statement made by the candidate is true to the best of my knowledge.

Dr. Shailendra Shukla

Asst. Professor

Department of Computer Science and IT

Dated:

Acknowledgements

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Vaibhav Gupta
Shubhank Gupta

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Abstract

The main objective of this project is to devise a simple low cost track monitoring system on the Indian railways using wireless technology which keeps track of the activities on the railway track using motion sensors and forwards any unusual activity to the train operator by SMS.

Also the system keeps track of the railway tracks using a variety of sensors such as temperature, humidity, etc.

This system can prove useful for monitoring the tracks and avoiding any accidents caused by trains.

CHAPTER 1 – INTRODUCTION

1.1. INTRODUCTION:

The Internet of Things: IOT truly signifies "all the things" (sensors and other brilliant gadgets) that are associated with the Net. Now since 2008, the quantity of things has dwarfed clients on the web. Mechanical advancements in this field are fast and now imply that these sensors can be created and sent in dense systems to screen climate and atmosphere. The scaling down and lessened expense of hardware is a major factor moving this change; be that as it may, the empowering advances are enhancements in batteries, communication, and cloud-based information stockpiling.

Lithium batteries are as of now demonstrating transformative over a scope of utilizations (e.g., electric vehicles), however they are additionally assuming a major job in the IOT. Sensors (e.g., to gauge temperature) can be controlled for quite a while from a solitary little cell. This progression alone tremendously lessens the expense of making an estimation, as an association with a mains supply or the consideration of an energy-creating solution is never again required. Communications are customarily one of the biggest depletes on vitality, as noteworthy power is expected to transmit the information. This can be overwhelmed by utilizing a designed arrangement, yet many climate outstations directly depend on the GSM. The little lithium battery is drained in merely hours due to their control eagerness. The IOT presently has a huge swath of low-control remote alternatives to conquer this. These incorporate Bluetooth, WI-Fi, and ZigBee over short separations (i.e., meters/viewable pathway), however the most recent improvements are seeing a quick sending of low-control wide zone systems (LPWANs). These are explicitly intended for the IOT (i.e., battery-worked sensors) and allow long-extend interchanges (i.e., ≥30 km adequately an entire city) with a solitary receiving wire. There directly exists a scope of contending gauges, for example, Long Range (LoRa), Sigfox, Long-Term Evolution (LTE), and Narrowband IOT (NB-IOT); be that as it may, all work on a similar low-power– low-piece rate rule to maximize battery life on the device. Thusly, an independent sensor would now be able to be found anyplace inside a wide territory where it will occasionally transfer information over the Internet to a server or "cloud."

Cloud-based capacity has now turned into the standard way to store information, and this advancement has additionally encouraged the fast development in the IOT by giving a steady and dependable intends to store the tremendous measures of information created by conceivably a huge number of gadgets. Cloud server and capacity arrangements are minimal effort, adaptable, and bespoke, taking into consideration stages to be effortlessly created to show substantial datasets continuously or to be sure to push (or draw) information by means of utilization programming interfaces (APIs) to end clients to ingest into estimating models. While gadgets themselves can be clever, empowering preparing errands inside firmware, the cloud takes into account a "savvy server– imbecilic sensor/customer" approach, which is desirable over alleviate against security dangers .

As an immediate aftereffect of these mechanical changes, the development of the IOT has been quick and is as of now making a noteworthy nearness in climate and atmosphere. Ongoing years have seen an upsurge in logical writing taking a gander at artful detecting (i.e., publicly supporting), which harvests information from the developing number of ease purchaser climate checking gadgets exploiting the previously mentioned advancements. For instance, the individual climate station has turned out to be productive, with a huge number of gadgets arranged far and wide. This implies in spots where there has been a past scarcity of climate information (e.g., urban areas), thick systems are presently accessible for climatologically examinations and, conceivably, climate administrations. Comparable advancements have likewise happened getting information from vehicles, where information can be separated before use to enhance information quality control utilizing vehicle information interpreters. Notwithstanding these examinations and without a doubt significant enthusiasm for the street climate area, the control remains comprehensively careful about the astute detecting approach. There are obviously issues in decaying the sitting and upkeep of hardware to the group, and these worries will stay until information quality control and confirmation are palatably managed. Interestingly, the key working standards really supporting the IOT are sound and as the accompanying use cases illustrate, when bespoke sensors are worked for committed applications and overseen by expert meteorologists, there is potential for the way to deal with be genuinely transformative.

This project not only shows the weather by Raspberry Pi with the help of sensors but it will have the capability of being used as means to avoid accidents. It will additionally give our project to share the related information through cloud to alert the workers of railways to make changes as per the conditions. By adding such applications to this project it not only helps the people around to know the weather but with the proper use of available sensor this project is capable of avoiding miss happenings. With the introduction to IOT it had been stated that modern world is becoming automated and everything is being connected to cloud to easily access anything at very low cost and with the user friendly interface. It is a much cheaper way to share the information with station master and train operators so as to reduce incidents that occur when there is no such information provided.

The proposed framework has five sensors that estimates distinctive parameters that is temprature,humidity,leaf wetness,speed and movement. Raspberry Pi, going about as data logger processes the change over yield of sensors from simple to advanced. The logged data would then have the capacity to be traded to a work zone or some other screen having has GUI for further examination. So by utilizing effectively gotten parts and less entangled hardware ground-breaking climate station can be constructed. Presently day by day's unique atmosphere factors like breeze and various different reasons to a great extent impact on individuals regular daily existence. In raspberry pi based atmosphere watching system which endless supply of a couple

of sensors to be consolidated has been proposed. Raspberry Pi will take all readings from the different sensors and after that strategy the data and a while later data will be open on cloud server for review of customer at remote territory. Weather Monitoring ought to be conceivable in either remote or wired way.The Raspberry is modest, little and tough which make it ideal for true activities. For rural advancement and modern administration, the proposed framework is valuable.

Such applications avoids the incidents that happens on railway tracks involving the train, the passengers of the train as well as the people who are crossing or walking on tracks.

Figure 1.1 IOT Ecosystem [1]

The above image explains how IOT has taken on our lives. With more and more gadgets connecting to the internet every day, IOT has played a major role in making the human life as

easy as possible. Be it switching on a light bulb from you phone or getting weather predictions of the next month ,all you have to do is give a simple command on your phone.

1.2 PROBLEM DEFINITION :

- INDIA is the land of the most vast railway system in the world. We all have heard so much about accidents happening on railway tracks that have resulted in numerous injuries and countless causalities..
- Other than that while railroads speak to a standout amongst the most effective methods of transportation, everyday climate can cause challenges. In summer, warm related deferrals on the railroad are a result of the clasping of rail route tracks.
- In fall, leaves on hold are a perpetual issue. Leaves that fall onto the track and are joined by a little measure of dampness minimal and make a Teflon type covering on the top of the tracks. This covering negatively affects braking execution, which prompts delays because of stage overwhelms and, crashes.

1.3 MOTIVATION:

INDIA may have made us proud by becoming the largest railway network in the world but when it comes to safety of the citizens, it could be said that the Indian railway has failed us. Let's just talk about 2017 and 2018 here and forget for a moment the rest of the years. Here's a list of accidents caused by the Indian railway in 2017 and 2018 alone.

1.3.1. 2017

- ON 21 January 2017 – The Kuneru train derailed and killed 41 and injured 68 people.

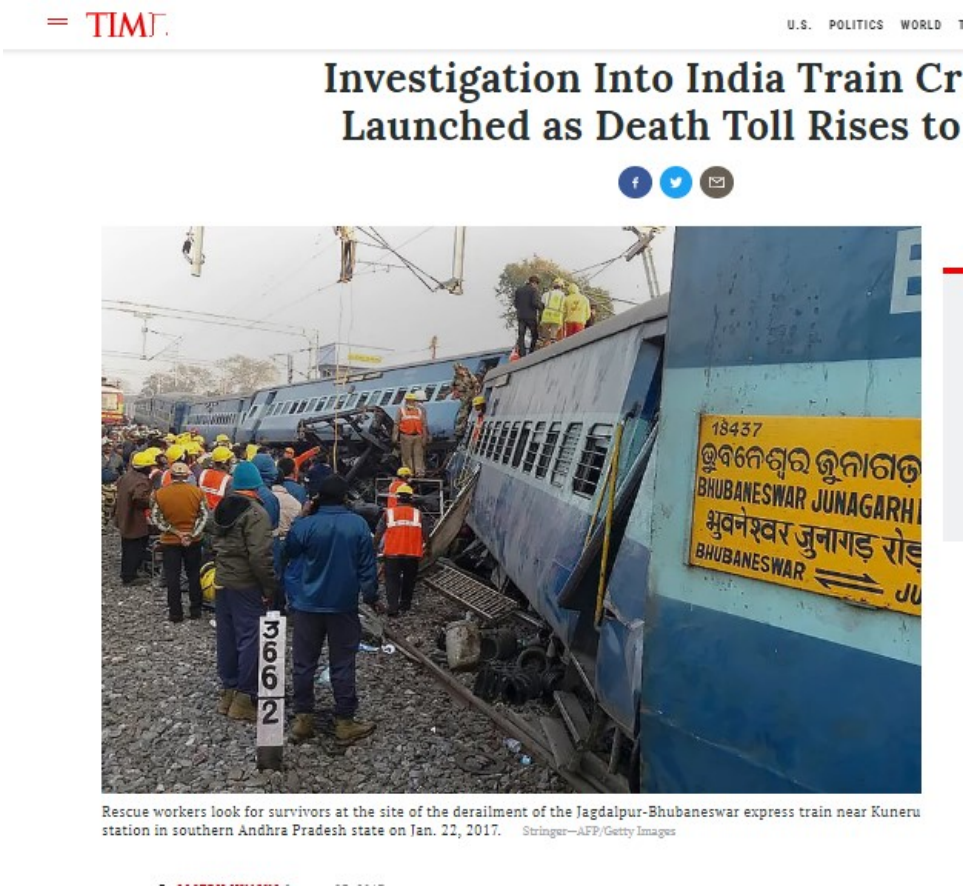

Figure 1.2 Train Crash Article[2]

- ON 19 August 2017 – The Kalinga Utkal Express derailed and killed 23 people and leaft around 97 people injured.

Figure 1.3 Khatauli Incident [3]

- ON 23 August 2017 – Auraiya train derailed. Around 100 people were injured.
- ON 24 November 2017 - Vasco Da Gama Express killed three people and leaving around nine injured.

1.3.2. 2018

- ON 10 October 2018 - New Farakka Express derailed with engine and 9 coaches and 7 people were Killed.
- ON 19 October 2018 - Amritsar train accident: Around 61 individuals were killed and around 100 harmed when a train kept running into a horde of observers who were remaining on the tracks viewing the Dusshera celebration in Amritsar.

Figure 1.4 Amritsar Train Accidents [4]

1.4 OBJECTIVES:

We intend to create a system that provides a solution to this problem.

- When heat monitoring is the issue, a temperature sensor or a thermopile sensor can be a means to provide the temperature of the rails.

- Autumn resilience is a bit challenging and will require and estimate of the total leaf fall daily and some observations from sensors to measure and record the temperature of the railway tracks, air temperature and the humidity .

- Of these, moistness on the tracks is the most imperative variable, as the littlest measures of water on the track are the most hazardous and proposes that a sensor needs the ability of recognizing these follow sums. This is conceivable utilizing IoT leaf wetness sensors situated on a "fake rail" along the edge of the live track .

- For the problem regarding the accidents caused by the trains,we intend to create a system that can track the heat signatures and notify the rail operators if there is a presence on the tracks.

- Now,being aware that the tracks have been layed on the farmlands, on roads , so it is quite obvious that there will be quite a moving acivity throught the tracks,so the information from the heat signatures will only be sent to the rail operators if there is a prolonged acivity on the tracks i.e, if someone is present on the tracks for a long duration of time only then will the operator be informed and necessary steps can be taken to avoid an accident.

1.4. METHODOLOGY:

1. The Idea is based on an entry-exit model and real time surveillance procedure wherein the entry and exit of people on the tracks will be monitored.
2. The primary objective of the model is to provide a system capable of tracking movement on the tracks and avoiding any accidents .
3. The checkpoints for monitoring will be located at various points on the rail, starting from the station following through to all possible tracks laid out between 2 successive stations.
4. At these checkpoints, the number of people passing will be checked in real time and a message will be sent to the station master and the rail operator if there is any prolonged activity on the rail to take the necessary steps.
5. The real time data will be uploaded to the cloud servers, from where they will be available to the Applications designed specifically for the purpose.

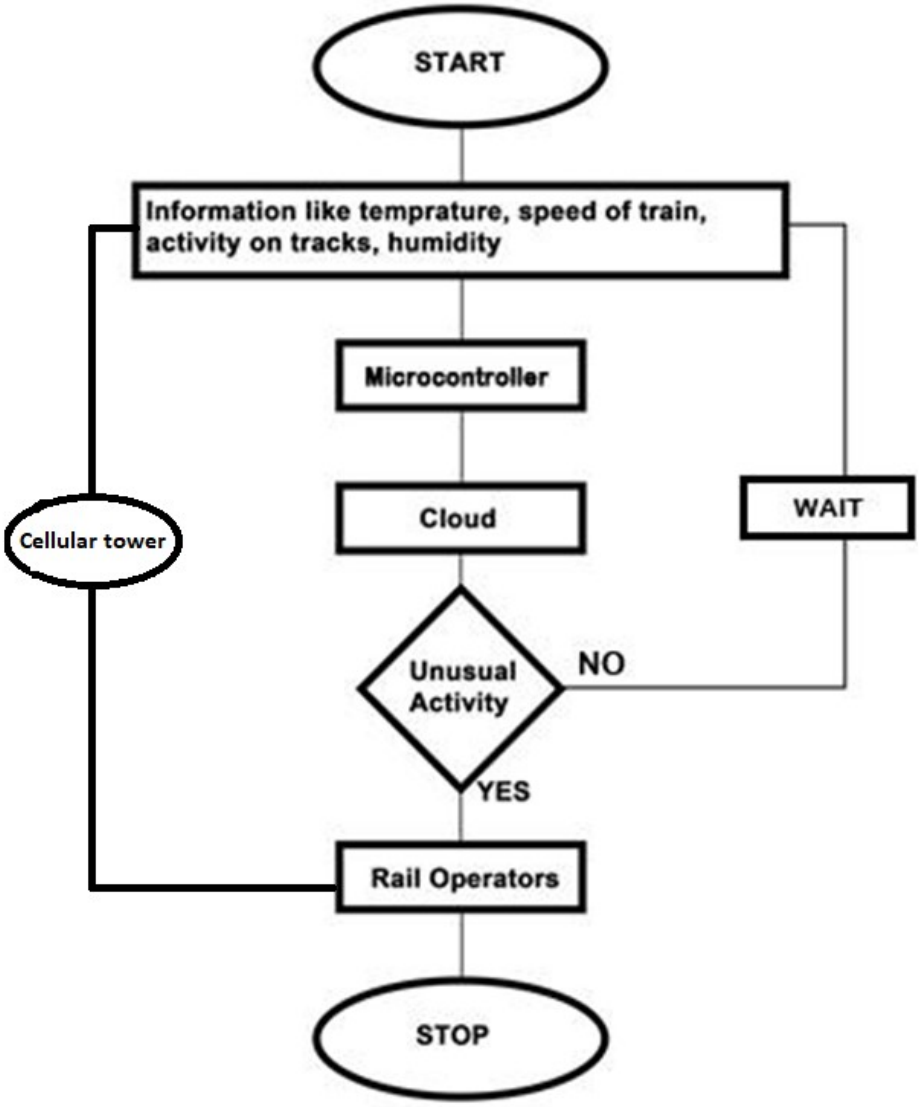

Figure 1.5 Information Sharing Flowchart

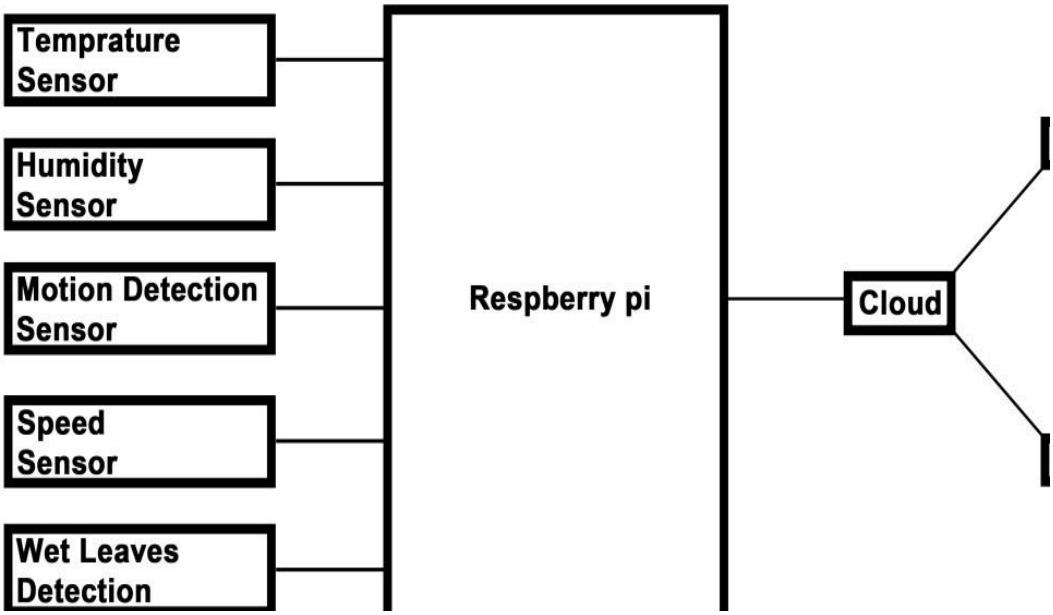

Figure 1.6 Connection with the Microcontroller

Working:

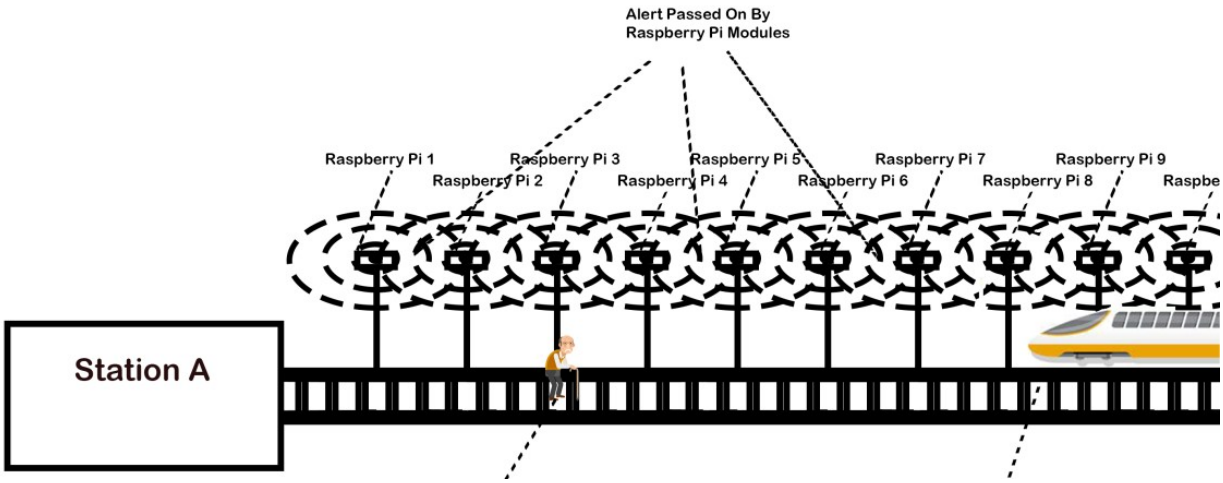

Figure 1.7 Working Model

The model is fitted into an accident prone area or an urban area. Suppose there is an acitivty on the tracks, the nearest sensor is activated by the activity and keeps track of the movement. An alert message is passed on from that checkpoint to all the checkpoints in the direction of the train and to a cellular tower. The message is receieved by the train operator by two ways.

A) From the checkpoint where the activity was detected, and alert message is sent to the nearest cellular tower, and from that cellular tower an sms is sent to the train operator informing him to slow down the speed of the train. But this can create latency as the model is placed in a remote area and may not have very good connection to the cellular tower.

B) A chain of alert messages is forwarded from the checkpoint that collected the data to all other checkpoints in the direction of the train and from the nearest checkpoint from the train the message is forwarded to the train operator thus slowing down the speed of the train.

1.5. Usage of the Proposed Model :

- **From a government point of view:**

With such a model placed on the tracks, the railway department will be able to keep a complete check on any sort of movement on the tracks and would be able to avoid any accidents.

- **For Mantainance:**

The railway department will be able to keep a track of the status of the rails and due to the information gathered by the sensors, would be able to moniter if the tracks need any kind of mantainance or replacement.thus avoiding any kind of accidents due to the derailment of the engine or coaches.

1.7. Advantages of our current system:

1. Keeping a record of temperature where the system is setup.
2. Keeping a record of the status of the railway tracks.
3. Keeping a record if there is someone present on the tracks.
4. Real time feeds of the rails.
5. Less number of accidents.
6. Complete record of all activities on the server.
7. Ease of accessing the records present on the server.

CHAPTER 2- LITRARY SURVEY

2.1 The Framework for Winter Road Maintenance and seasonal resilience on the railways to showcase the potentially transformation impact of the Internet of Things on observation and forecasting.

Lee Chapman and Simon J. Bell

The main reason behind this paper was to highlight the requirement for high-resolution sensor networks and indeed the metamorphic potential that IoT holds for automating the houses and cities and improve the resilience of infrastructure. As we all know the most reliable and efficient mode of transportation are the railways. During Summer time buckling of railway tracks as well as the overheating of lineside equipment causes heat- related delays all the time. During autumn perennial problem are caused due to the leaves on the line. Leave being accompanied by water collected on it (e.g. dew or rain water) make a Teflon type coating on the line of tracks. It negatively affects the breaking performance; it may lead to various delays due to signal pass at danger or platform overrun. To maintain a strategic distance from these circumstances climate gauges are utilized to know the climate and force speed limitations to diminish security effects of kicking amid sweltering climate or to enhance bond at the issue area by spreading sandite onto the tracks at the season of pre-winters.

2.1.2. Operating Procedure

A minimal effort street surface temperature sensor utilizing a thermopile is produced . In view of the full arrangement of IoT standards, it expends insignificant vitality and can be fueled for a full fall season utilizing two standard, off-the-rack, AA soluble batteries. LPWAN (where accessible) and Wi-Fi are the two Communication choices. The exactness of perceptions stays pivotal for street climate applications, so it is critical to decide if minimal effort sensors are adequately precise. Research facility testing can be utilized to expand trust in this methodology , and the outcomes show that exact perceptions of street surface temperature currently seem, by all accounts, to be conceivable utilizing minimal effort IoT sensors . In the field, information are handed-off progressively to the cloud, where it experiences quality-control preparing (e.g., predisposition adjustment/separating to evacuate movement impacts) before being shown to the end client.

2.1.3. Conclusion and Future work

This paper gave us the idea to add motion detection in our project as it will aware us about the leaves that will fall on track and will get detected even the people walking on the tracks will get detected. Our project will have the infrastructure of giving us the information about temperature as well as the amount of water present in the atmosphere. Even alert the station master so that he can impose some orders on train operator if there is any need so as to avoid such miss-hap. The IoT has the potential to completely change decision-making and operations on infrastructure. It will unlock the potential of high resolution models as well as stimulate further innovation, increasing the weather resilience of infrastructure. Aside from infrastructure improvements, the IoT will promote

new developments in the weather industry, including open data and opportunistic sensing.

2.2 Internet of Things (IOT) Based Weather Monitoring system

Bulipe Srinivas Rao , Prof. Dr. K. Srinivasa Rao , Mr. N. Ome

This paper is about monitoring the weather of a given place and makes it accessible anywhere around the world. The idea and the innovation behind this is to establish network and use it to generate the information to make it shareable and connectable using Internet of Things. These things are normally the microprocessor, controllers, gadgets, sensors and the other electronic equipments. This system works by monitoring the conditions of the environment that affects our daily routine like atmospheric temperature, humidity or the amount of water present in the air, intensity of light and the level of Carbon Monoxide with the help of sensor and share the information online to generate graphical statics from the data generated. This information that is being shared and the graphs generated are accessible from anywhere through internet.

2.2.2 Operating Procedure

The executed system conatins a microcontroller (ATmega328) as a primary controlling unit for the entire system and each sensor is linked with it.The microcontroller worls the sensors to collect information from them and the sensor information is updated to the web using the WI-FI module that is associated with the microcontroller. Every one of the modules in the circuit are associated with Arduino module. Arduino UNO board is associated with sensors for checking.

2.2.3 Conclusion and future works

By keeping the implanted gadgets in the earth for observing empowers self assurance to the earth. To execute this we need to convey the sensor gadgets in nature for gathering the information and investigation. By sending sensor gadgets in the earth, we can bring nature into real life i.e. it can communicate with different parameters through the system. At that point the gathered information and investigation results will be accessible to the end client through the Wi-Fi. The brilliant method to screen condition and a productive, minimal effort inserted frame work is given distinctive models in this paper. In the proposed design elements of various modules were talked about. The commotion and air contamination checking framework with Internet of Things (IoT) idea tentatively tried for observing two parameters. It additionally sent the sensor parameters to the cloud (Google Spread Sheets). This information will be useful for future investigation and it very well maybe effortlessly shared to opposite end clients. This

model can be additionally extended to screen the creating urban communities and modern zones for contamination checking. To shield the general wellbeing from contamination, this model gives a productive and minimal effort answer for nonstop observing of condition.

CHAPTER 3- SYSTEM DEVELOPMENT

3.1 HARDWARE USED:

The proposed system requires the following components:

1. Temperature Sensor
2. Humidity sensor
3. Leaf wetness sensor
4. Motion Sensor
5. PIR sensor
6. Buzzer
7. Speed sensor
8. Raspberry Pi
9. Arduino

3.1.1. Temperature sensor

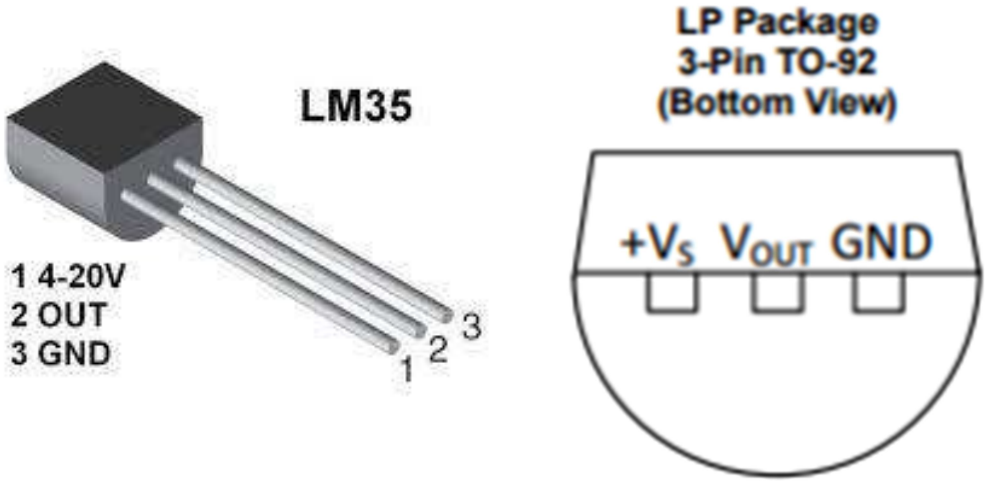

Figure 3.1 LM35 &Pin Diagram[5]

The LM35 is a temperature sensor that can be used to quantify temperature with an electrical output relative to the temp. (in °C). It can quantify temperature more effectively in contrast to a thermistor. This sensor makes a high return voltage than thermocouples and may not necessitate that the yield voltage is upgraded. The sensor has

an output voltage that is relating to the Celsius temperature. The scale factor is .01V/°C. The sensor does not require any outside change and keeps up an exactness of +/ - 0.4°C at room temperature and +/ - 0.8°C over an extent of 0°C to +100°C.One more basic typical for this sensor is that it draws just 60 microamps from the supply .

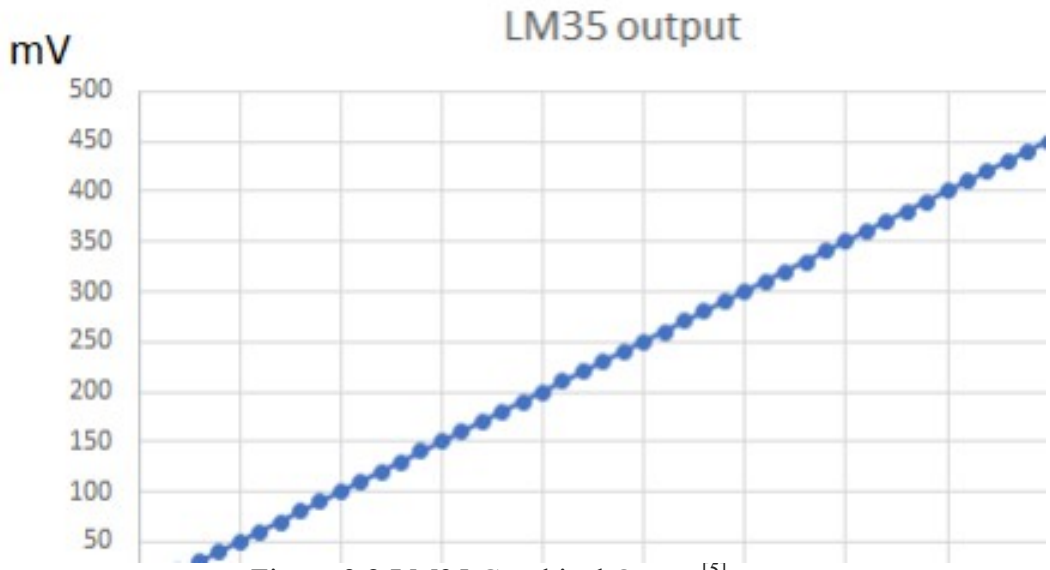

Figure 3.2 LM35 Graphical Output[5]

Advantages:

• The affectability of the sensor is 10mV/˚C.

• The output of the temperature sensor is opened up using a LM324 single power supply (+5V) .

• A pick up of 5 is intended for the operation amp.

• The temperatures are measured with a determination of up to 0.5 deg. Celsius by the hardware.

• A simple formula is used to change the yield voltage over to temperature . The general formula used to change over yield voltage to temperature is:

Temp (˚C) = (Vout * 100)/5 ˚C
So if Vout is 5V, then, Temperature = 100 ˚C]

3.1.2. Humidity sensor

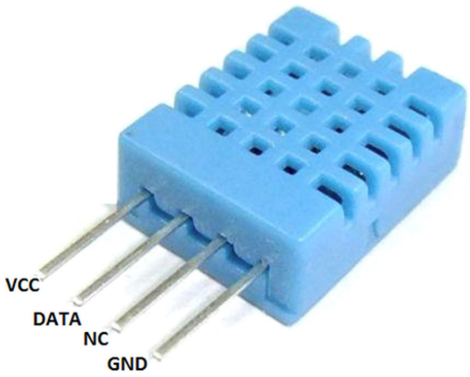

Figure 3.3 Humidity Sensor[6]

Humidity Sensors are critical gadgets that assistance in estimating the ecological dampness. In fact, the gadget used to gauge the dampness of the air is called Hygrometer. Dampness Sensors or Hygrometers can be grouped dependent on the kind of humidity it is utilized for estimating i.e. Total Humidity (AH) sensors or Relative Humidity (RH) sensors. Stickiness Sensors can likewise be grouped dependent on the parameter utilized for estimating Humidity i.e. Capacitive Humidity Sensors, Electrical Conductivity Humidity Sensors and Thermal Conductivity Humidity Sensors.

3.1.3. Leaf wetness sensor

Figure 3.4 Leaf wetness sensor[7]

The LWS, made by METER Environment, can distinguish little measures of water or ice on the sensor surface for leaf wetness applications. Since the LWS estimates the dielectric consistent of the sensor's upper surface, it can distinguish the nearness of water or ice anyplace on the sensor's surface.

The LWS is intended to be conveyed either in the shelter or on a climate station pole. Two openings in the non-detecting bit of the sensor body are accommodated appending the sensor to a shaft or branch by means of turn ties or with 4-40 jolts.

3.1.4. Motion sensor

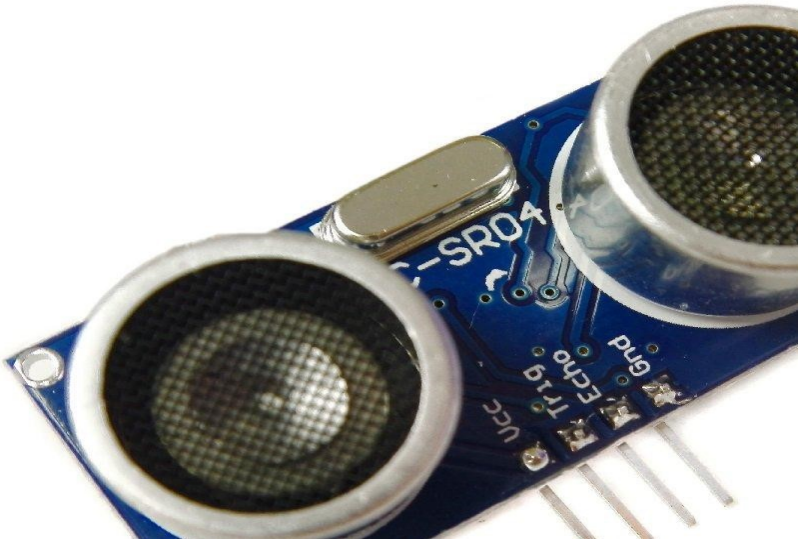

Figure 3.5 Motion Sensor[8]

An electronic movement identifier contains an optical, microwave, or acoustic sensor, and as a rule a transmitter for light. Be that as it may, a detached sensor detects a mark just from the moving article through outflow or reflection, i.e., it tends to be discharged by the question, or by some surrounding producer, for example, the sun or a radio station of adequate quality. Changes in the optical, microwave, or acoustic field in the gadget's vicinity are deciphered by the hardware dependent on one of the advances recorded underneath. Most minimal effort movement locators can recognize up to separations of no less than 15 feet (4.6 m). Specific frameworks cost more, yet have any longer ranges. Tomographic movement identification frameworks can cover a lot bigger regions in light of the fact that the radio waves are at frequencies which enter most dividers and hindrances, and are recognized in numerous areas, not just at the area of the transmitter. Here in our project we will use these sensors to detect any movement on the railway tracks and any prolonged movement will be immediately notified to the traion operator.

3.1.6. PIR Sensor

PIR (Passive InfraRed) motion sensor

Motion PIR (Passive InfraRed) sensor reacts only to certain energy sources like head released by the human or animal bodies. Its operation is based on perceiving the difference of infrared radiation in the surrounding area. It is constituted by a crystalline material which generates a surface electric charge when it is exposed to head in form of infrared radiation, when the quantity of radiation perceived changes, it contains a Fresnel filter which changes output in order to indicate movement in surroundings. It also contains an amplifier, which behaves as an active filter rejecting the high frequency

noise, followed by a comparator which responds to a positive and negative transitions from output sensor signal.

Figure 3.6 PIR Sensor[9]

This sensor includes detection elements configured to cancel signals caused by vibration, temperature changes or sunlight. It has two variable calibration resistors: one is for establish the time that its output is kept, the other is to vary detection distance between 3 and 7 meters.

Main characteristics:

- Supply voltage: 4,5 – 20 V
- Controller: PIR BISS0001
- Detection range: 3-7 m
- Fresnel lens: 19 zones, angle < 100º
- Configurable output timer by trimmer (Tx)
- Configurable retrigger by jumper

➢

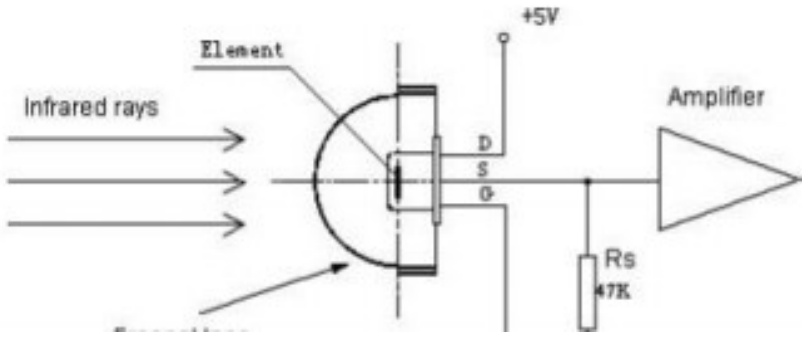

Figure 3.7 PIR Sensor Pin Diagram[9]

3.1.7. Buzzer

Is a piezoelectric transducer, a device that converts electrical signals into sound. Piezoelectric materials have the possibility of varying its volume when being crossed by electrical currents. A buzzer takes advantage of this phenomenon to vibrate a membrane by traversing the piezoelectric material with an electric signal.

Figure 3.8 Buzzer[10]

3.1.6. Speed sensor

Figure 3.9 Speed Sensor[11]

A **wheel speed sensor** or **vehicle speed sensor** (VSS) is a type of tachometer. It is a sender device used for reading the speed of a vehicle's wheel rotation. It usually consists of a toothed ring and pickup.

The most common wheel speed sensor system consists of a ferromagnetic toothed reluctor ring (tone wheel) and a sensor (which can be passive or active).

The number of teeth is chosen as a trade-off between low-speed sensing/accuracy and high-speed sensing/cost. Greater numbers of teeth will require more machining operations and (in the case of passive sensors) produce a higher frequency output signal which may not be as easily interpreted at the receiving end, but give a better resolution and higher signal update rate. We will use this sensor to track the speed of the trains and send a message to slow down the speed in case of an unusual activity on the tracks ahead.

3.1.7. Raspberry Pi

Figure 3.10 Raspberry Pi[12]

The Raspberry Pi that is being used in this project is Raspberry Pi 3. It is a 3 rd era Raspberry Pi.
In February 2016 displaced the Raspberry Pi 2 Model B. In comparison to Raspberry Pi 2 itconsists of :

- 1.2 GHz quad-center 64-bit ARMv8 Central Processing Unit
- 802.11 n Wireless LAN 30
- Bluetooth 4.1
- Bluetooth with low energy (BLE)

In addition to Raspberry Pi 2 specs it consists of:

- RAM of 1GB
- Four USB Ports
- GPIO Pins-40
- Full HDMI connectable Port
- Ethernet
- Composite video combined with 3.5mm jack
- CSI-Camera Interface
- DSI-Display Interface

- Micro SD card slot

The Pi3 has a clear frame variable in addition to the older Pi 2 as well as older and it also finished the similarity with the older Raspberry Pi 1 and Respberry Pi 2. We suggest to use this project's Respberry Pi at schools or for any other expensive use, as it consists of 1GB RAM (i.e. twice as good as A+), 4 USB ports, 40 GPIO pins, Ethernet. But it would be beneficial to use Pi Zero or Model A+, as it will be better for embedded system and the activities that requiring low power.

Gpio in Raspberry Pi

To interface physical gadgets with the Linux processor such as catches and LEDs GPIO sticks on Raspberry Pi 3 is amazing approach. There is a sweet library RPi for Python designer, GPIO working as interfacing in pins. We are able to flicker LED with just a 3 lines of code. It's faster and makes things easier too.

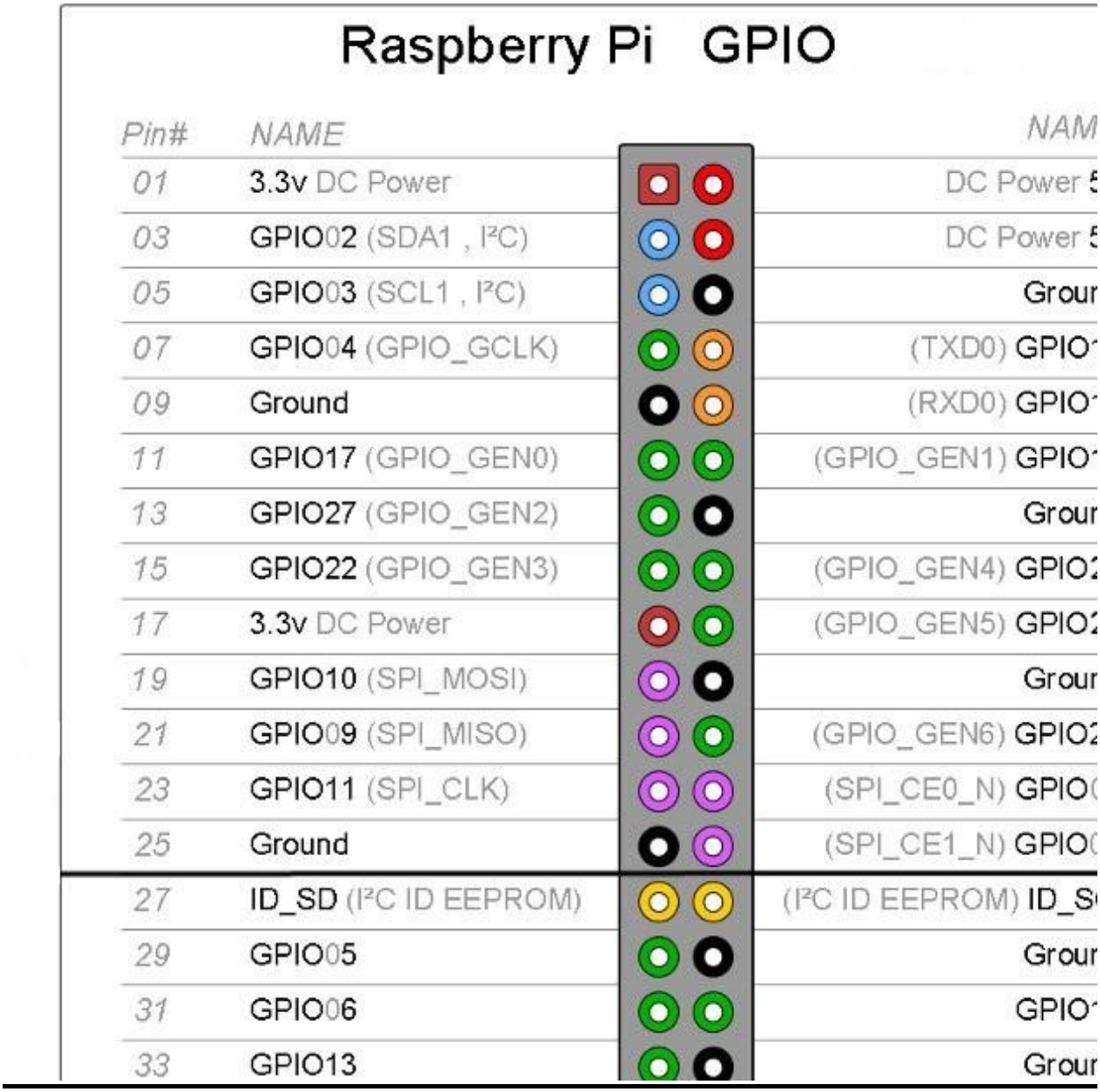

Figure 3.11 Raspberry Pi GPIO[13]

3.1.8 Arduino

Figure 3.12 Arduino[14]

Arduino board plans utilize an assortment of chip and controllers. The board are furnished with Analog and Digital ip/op (I/O) sticks that might be interfaced to different extension boards or breadboards (shields) and different circuits. The sheets highlight sequential correspondences interfaces, including Universal Serial Bus (USB) on certain models, which are likewise utilized for stacking programs from PCs. The microcontrollers are commonly customized utilizing a lingo of highlights from the programming dialects C and C++. Notwithstanding utilizing conventional compiler toolchains, the Arduino venture gives a coordinated advancement condition (IDE) in view of the Processing language venture.

GPIO in Arduino

An average microcontroller can have somewhere in the range of 6 and 60 pins on it, to which we're relied upon to append power supply, I/O connection. Each microcontroller has various arrangements for its pins, and regularly one pin will have more than one capacity. This multitasking of one pin is called pin multiplexing.

Each microcontroller has names for the pins explicit to its equipment, however the Arduino application programming interface (API) gives a lot of names to pins and their capacities that should work over all microcontrollers that are programmable with the API. Along these lines, for instance, A0 will dependably be the simple info pin 0, regardless of whether you're on an Uno, 101, MKRZero, MKR1000, or other Arduino-good board. When you associate with the stick with a similar capacity on another board, your code ought to work the equivalent, despite the fact that the physical design of pins is unique.

Each board has a working voltage that influences its pins too. The working voltage, which is equivalent to the voltage of the GPIO pins, is named underneath. In case you're interfacing a segment to a board with a lower voltage than the part, you'll have to do some level shifting.

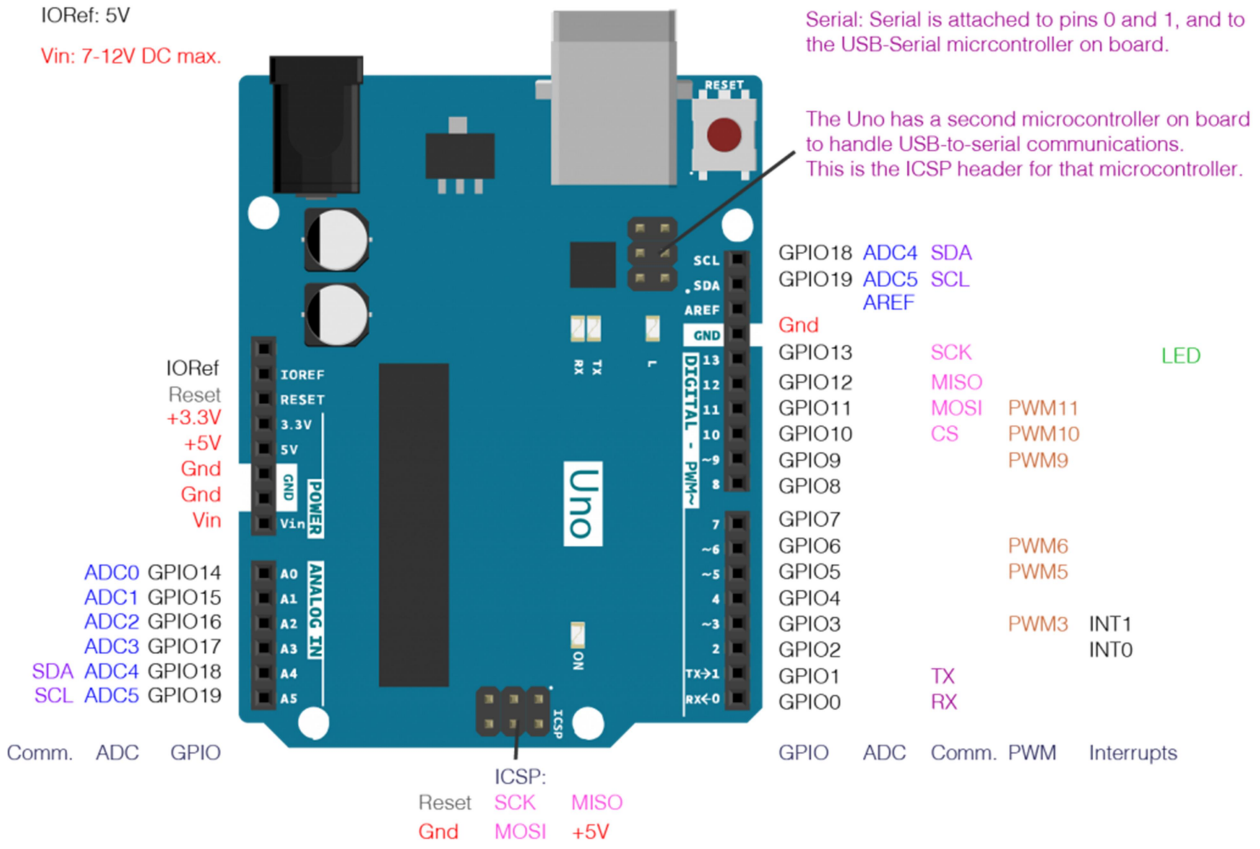

Figure 3.13 Arduino GPIO[15]

Comparison Between Arduino Uno &Raspberry Pi

Point of comparison	Arduino UNO	Ras
Model	UNO R3	M
Price	150 LE	4
Processor	ATMega 328	A
Clock Speed	16 MHz	70
RAM	2 KB	5
Flash	32 KB	SD
EEPROM	1 KB	
Input Voltage	7-12 V	
Min. Current	42 mA	7(
Digital I/O	14 (2 serial Tx/Rx)	
Analog Input	6 (10-bit)	
PWM	6	
I^2C	2	
SPI	1	
UART	1	
Operating System	-	L
Programming Language	AVR C Only	Python Java / Sc
Ethernet	-	1(

Figure 3.14 Arduino GPIO[16]

3.2. Communication

To establish the communication needed between Arduino and mobile application are studied the most commonly used communication technologies.

3.2.1. Overview of standard communications

- **Wi-Fi**

Wi-Fi is a WLAN (Wireless Local Area Network), the option in contrast to the wired neighborhood arrange that utilizes TCP/IP protocol. The name is an enlisted brand, abbreviation of Wireless Fidelity, and there are a large number of gadgets empowered to utilize this sort of correspondence.

- **Bluetooth**

Bluetooth is a modern tech for WPAN (Wireless Personal Area Network), that empowers the transmission of information and voice between various gadgets through a radio frequency connect in the 2.4 GHz ISM band. The primary destinations to be accomplished with this standard are encourage correspondence between cell phones, evacuate links and connectors among them and offer the likelihood to make little remote systems encouraging the synchronization of information between close to home hardware. All Bluetooth gadgets have a special location of 48 bits and a gadget name that permits the recognizable proof of one another. Gadgets that consolidate this convention can connect with each other when inside its range. The interchanges are by radiofrequency with the goal that the gadgets don't need to be adjusted and can even be in discrete rooms if the transmission control is adequate. These gadgets are delegated Class 1, Class 2 and Class 3 relying upon the transmission control.

There are two principle Bluetooth modules compatibles with Arduino and different microcontrollers: HC-05 and HC-06. These are both of Class 2 and simple to utilize because of its SPP (Serial Port Protocol). Bluetooth module HC-06 is just skilled to function as Slave, it implies that it very well may be associated just to a Master and it has a decreased arrangement of guidelines which it can visit. Then again, Bluetooth module HC-05 is fit both to function as Slave and as Master, it very well may be associated with a more than one Slave and get and demand data from every one of them, parleying the exchange of data (most extreme 7 slaves) and can take care of a more noteworthy number of setup directions.

➢ Bluetooth communication

After a worldwide correspondence review, it is chosen to utilize Bluetooth for the correspondence among Arduino and versatile application, all the more explicitly HC-05 module. This module is at long last picked to meet all application necessities. It is a remote innovation, the sender and the beneficiary are not physically associated, however through electromagnetic waves. It has a scope of 10 meters, enough to have the option to control the factors utilizing cell phone, since this kind of control bode well when the client is inside the house. At last, the main extra prerequisite to make the correspondence between the two gadgets is that the cell phone has Bluetooth availability, which these days is a standard normal for mobiles.

Main characteristics:

- Security: Authentication and encryption.
- Configurable as Slave and as Master.
- Operation temperature: -20 ºC – 75 ºC.
- Frequency: 2.4 GHz ISM band.
- Emission Power: ≤ 4 dBm (Class 2).
- Modulation: GFSK (Gaussian Frequency Shift Keying).
- Speed: Asynchronous: 2.1 Mbps/160 kbps; Synchronous: 1 Mbps/1 Mbps.
- Built-in PCB antenna.
- Range: 10 m.
- Current consumption: 50 mA.
- Profiles: Serial port Bluetooth.
- Supply voltage: 3.6 V – 6 V.
- Radio chip: CSR BC417143.

3.3 SOFTWAREWARE USED:

3.3.1. RASPBIAN OS:

Raspian OS is one of the expert Operating structures open to no end to download and use. The system relies upon Debian Linux and is progressed to work profitably with the Raspberry Pi . As we unquestionably understand an OS is a game plan of fundamental programs and utilities that continues running on a predetermined hardware, for this circumstance the Pi. Debian is uncommonly lightweight and settles on a remarkable choice for the Pi. The Raspbian consolidates mechanical assemblies for scrutinizing, python programming and a GUI work territory.

The Raspian work region condition is known as the "Lightweight X11 Desktop Environment" or in short LXDE. This has a truly engaging UI that is developed using the X Window System programming and is a characteristic point and snap interface.

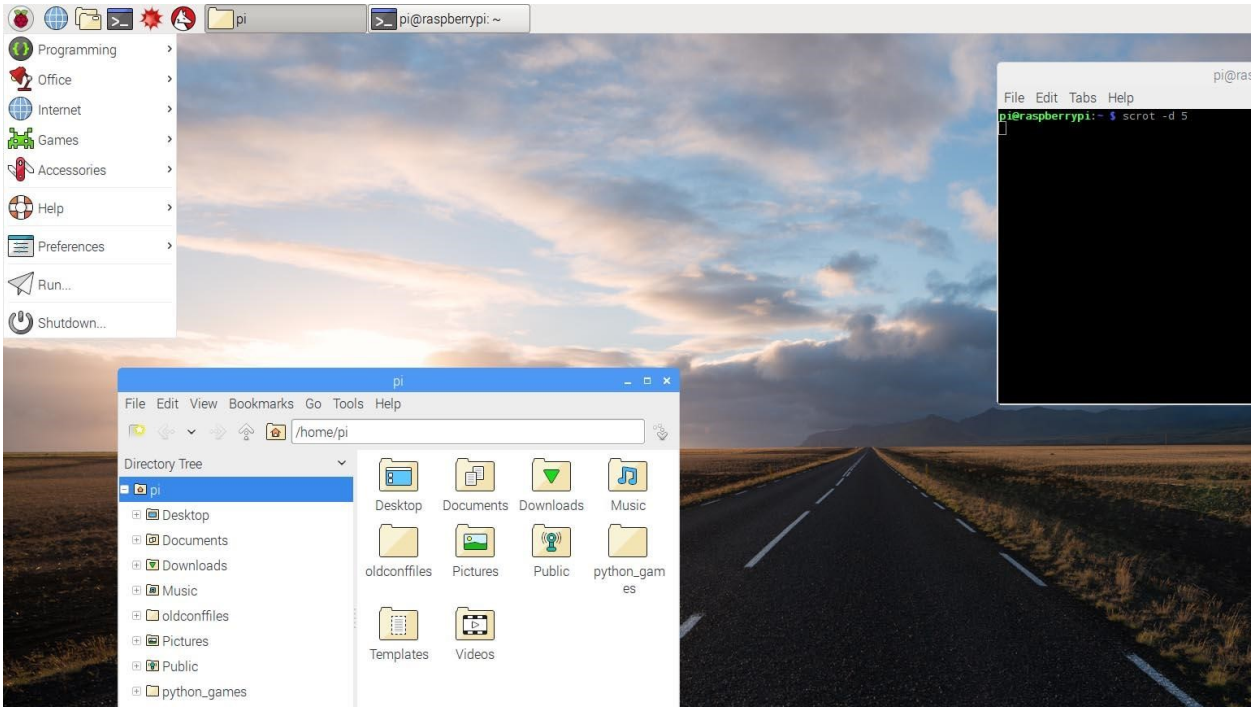

Figure 3.15 Using Raspian OS

3.3.2. PYHTON PROGRAMMING:

Power up our Raspberry Pi and then booting all the way in to our operating system GUI.

- We just create a new file with the extension .py
- Then type the following code:

importRPi.GPIO as GPIO
GPIO.setmode(GPIO.BCM)
GPIO.setup(17, GPIO.OUT)
GPIO.output(7,True)

- To save type :wq!
- Then we run our program. We would now see our led light up and

then some voltage (+3.3v)will be supplied into our circuit by using GPIO pin 17.

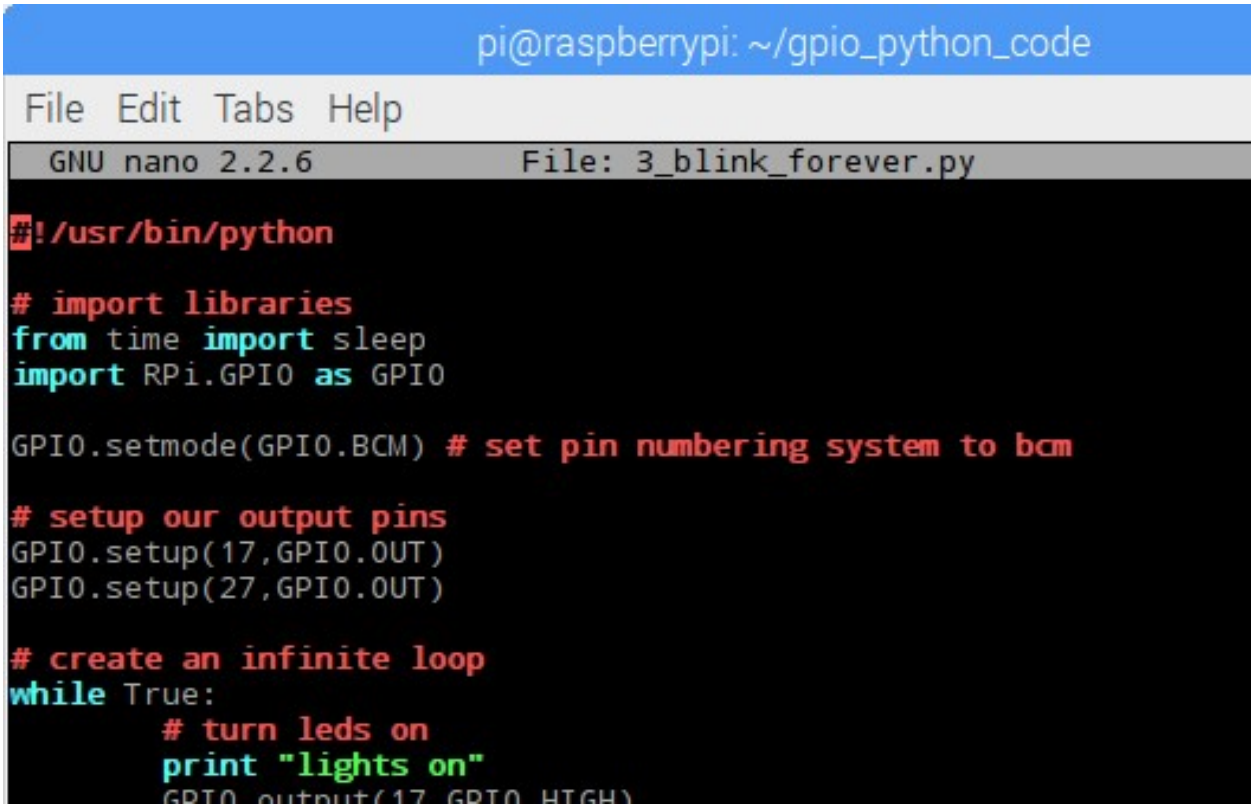

Figure 3.16 Using Python Programming

CHAPTER 4- PERFORMANCE ANALYSIS

4.1. Component Calculatons:

4.1.1. Temperature Sensor-

As is indicated in ATmega2560 microcontroller datasheet of Atmel maker, it consolidates a 10-bit ADC.

On the off chance that is taken a temperature scope of 0 to 100 ºC and LM35 temperature sensor is aligned with the goal that every degree Celsius is equivalent to 10 mV as output

:

$$100℃ \times 10mV = 1V$$

At the most extreme temperature the o/p will be 1 V and the greatest estimation of ADC is 5 V, so it implies that a level of range is lost:

$$resolution = \frac{5V}{2^{10}} + \frac{5V}{1024} = 4.88mV$$

It is conceivable to switch inner voltage reference of microcontroller to 1.1 V by code and for this situation the goals will be progressively accurate:

$$resolution = \frac{1.1V}{2^{10}} + \frac{1.1}{1024} = 1.07mV$$

It tends to reach also by including a voltage divider or an amplifier:

ach too by adding a voltage divider or an ampl

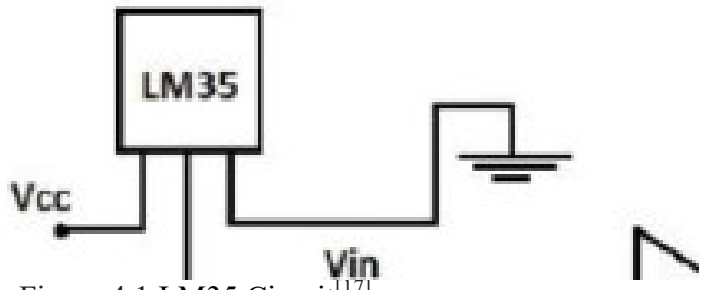

Figure 4.1 LM35 Circuit[17]

$$V^+ = V_{in}$$

$$V^- = \frac{V_{out}.R1}{R1 + R2}$$

$$V^+ = V^-$$

$$Gain = \frac{V_{out}}{V_{in}} = \frac{R1 + R2}{R1} = \frac{R2}{R1}$$

$$Gain\ wanted = 5;$$

$$5 = 1 + \frac{R2}{R1}$$

$$If\ R1 = 1k\Omega;$$

$$R2 = (5 - 1).1000 = 4k\Omega$$

$$100℃.0.05 = 5V$$

Thus, in conditions of 100 ºC (maximum range value) LM35 sensor will give 5 V as output signal.

The main answer for increment goals is risky for the unwavering quality of the other analog sensors results, which must be referenced to 5 V. The code isn't so quick as to have the option to change without a doubt voltage reference on each sign perusing and false qualities can be acquired for the two sensors referenced to 5 V and 1,1 V.

The second arrangement is more safe for the great capacity of the framework and it will be picked if there should arise an occurrence of fundamental, yet additionally has hindrances. It builds the trouble of the circuit since it must be fueled with symmetrical voltage not the same as 5 V expanding the cost as well.

The motivation behind the temperature control of this task isn't to have an incredible temperature goals, it is adequate to picture the difference in entire degrees (without need of decimals) so when the limit is come to (regularly at 25 ºC) being in programmed mode, turn on the fan. On account of remote mode is likewise a bit much, as the client choose by its very own warm sensation if the fan in turned on or not. Thus, at last the temperature changes that can catch this venture will be around 0,5 ºC, having a yield of 0 V at 0 ºC and 1 V at 100 ºC.

4.1.2 PIR Sensor

PIR sensors are more complex than a considerable lot of different sensors clarified in these instructional exercises (like photocells, FSRs and tilt switches) on the grounds that there are various factors that influence the sensors I/O. To start clarifying how a fundamental sensor functions, we'll utilize this rather nice diagram

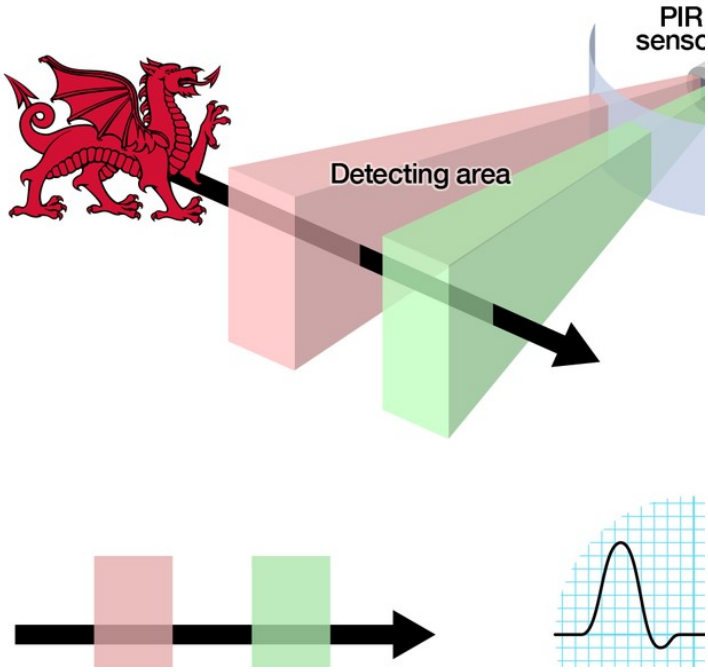

Figure 4.2 PIR Sensor Detecting Movement[17]

The PIR sensor itself has two slots in it, each opening is made of a unique material that is sensitive to IR. The lens utilized here isn't generally doing much thus we see that the two openings can 'see' out past some separation (fundamentally the affectability of the sensor). At the point when the sensor is inactive, the two spaces identify a similar measure of IR, the surrounding sum emanated from the room or dividers or outside.

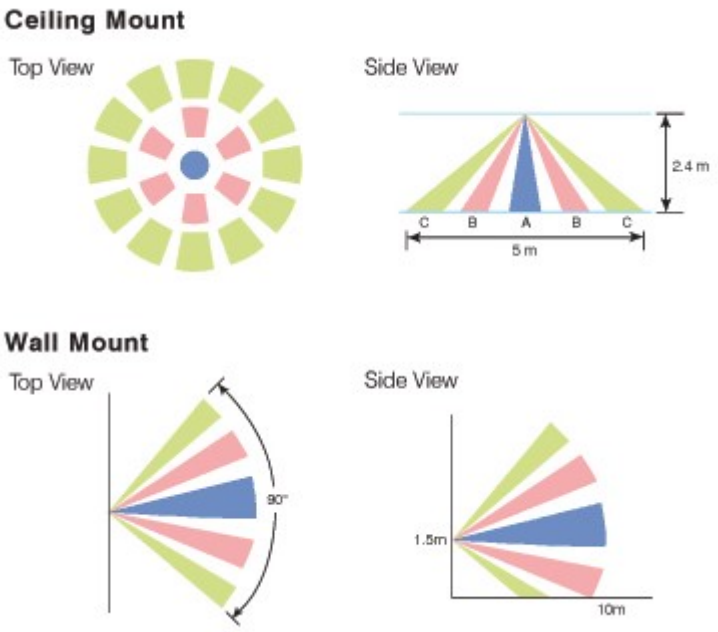

Figure 4.3 Different Angles of PIR Sensor[18]

At the point when a warm body like a human or creature cruises by, it first catches one portion of the PIR sensor, which causes a positive differential change between the two parts. At the point when the warm body leaves the detecting territory, the turn around occurs, whereby the sensor creates a negative differential change. These change beats are what is recognized.

4.2 Result

Temperature Sensor

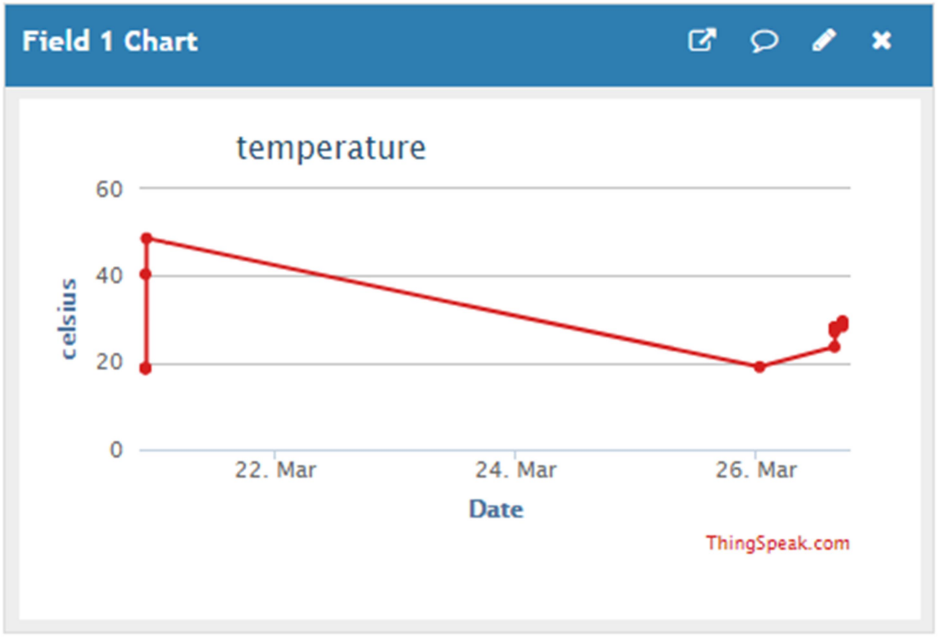

Figure 4.4 LM35 Readings[18]

A) The sensor collected data for 6 days for 15 minutes daily at different times and the avrage temprature was calculated based on that data. The tempratures were then plotted on a graph.

B) For motion detection, a model was set up with 2 raspberry pi's and a PIR sensor. A person (assuming it is train) walked by in front of a pi. As a result a buzzer rang as soon as the motion was detected and the message was passed on to the next raspberry pi.

CHAPTER 5 – CONCLUSION

5.1. MAJOR ISSUES:

The major issues that will be tackled include but are not limited to:

1. A complete record of the people passing through the tracks will be kept using the motion sensors installed at checkpoints and in case of any unusual activity ,the station masters will be informed.

2.The speed sensors installed at the checkpoint will continuously check the speed of the trains and in case of any unusual activity on the track ahead, the operators will be informed to slow down the speed of the trains.

3.The leaf wetness sensors will check for the amount of dew present on the leaves and a record for the number of falling leaves on the track will be kept through the motion sensors.

4. The temperature sensor and the humidity sensors installed on the dummy rails will keep a record of the temperature of the rails and in case of any unusual change, the station masters will be informed to check for mantainance.

5. All the records will be sent over and stored in the cloud and would be accessable through a mobile app and in case of any irregularities, the necessary authorizes would be informed immediately to take necessary action.

5.2. Future Scope:

1) At first, the model is fitted only in accident prone areas but if it is success, the model can be layed out on the entire railway tracks of our country.

2) A gps tracker can also be fitted in every train to monitor the movement in real time.

3) Specific sensors that can monitor the tracks can be developed and we will never have to worry about derailment again.

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