Smart Traffic Management Using Internet of Things (IoT)

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Abstract- Smart Traffic Management System', is based around the idea of solving traffic management and control problems using efficient algorithmic solutions and then carrying on the idea to the stage of creating energy efficient systems for traffic control.

Indexed Terms- IoT, Smart City, Smart Traffic Management, Traffic Congestion, Traffic Signal Management.

I. INTRODUCTION

The Internet of things (IOT) describes physical objects (or groups of such objects) with sensors, processing ability, software, and other technologies that connect and exchange data with other devices and systems over the Internet IOT enables companies to automate processes and reduce labour costs. It also cuts down on waste and improves service delivery, making it less expensive to manufacture and deliver goods, as well as offering transparency into customer transactions.

AI which stands for artificial intelligence refers to systems or machines that perform continue tasks and can improve themselves based on the information they collect. AI is said to be a human machine because it collects its own data and doesn't need human interference . For example, Siri on our phone once said that this number is for my mom, then immediately registers it in the phone directory and keeps using it when we voice mom on Siri.

The relationship between IOT , Big Data and Cloud Computing creates opportunities for businesses to have exponential growth. Put simply, IoT is the source of data, Big Data is an analytic platform of data, and Cloud Computing is the location for storage, scale and speed of access.

- Purpose of study

The Internet of Things (IoT) is creating much buzz while it goes about transforming our lives. IoT is everywhere, even though we don't always see it or know that a device is part of the IoT. The IoT is turning physical objects into an ecosystem of information shared between devices that are wearable, portable, even implantable, making our lives technology and data rich. IoT business applications are numerous. Smart machines are changing when, where and how work is done in virtually every industry; but, what does it mean for real life? IoT is an unprecedented network connecting machines, individuals, data and processes and is now filtering down to real-life, shaping how we go about our daily lives. Some real-world examples of IoT are wearable fitness and trackers (like Fitbits) and IoT healthcare applications, voice assistants (Siri and Alexa), smart cars (Tesla), and smart appliances (iRobot). With IoTs rapid deployment coming into contact with multiple IoT devices every day will be unavoidable soon.

- Implications of study

There has been rise of IOT devices significantly through coming years and would continue to grow in smart cities. As it was mentioned earlier about implementing of smart traffic management system in Bengaluru city would help avoid loss of time and traffic congestions by having camera and sensors as it could record the speed of particular vehicle and information of the vehicle, unlike many other traffic system which have a mechanism to change that changes light after a particular time but through smart traffic management system senses the presence or absence of vehicles and reacts accordingly. These systems have been in use in cities like California and Los Angeles. However as we all know anything connected to the Internet has a risk of being hacked and this could lead to blackout of traffic camera's, tampering with traffic lights and could be risky for the public on road. So it is very necessary that these

system have good Firewall. A firewall is a network security device that monitors all incoming and outgoing traffic and permits, block or drop data packets based on a defined set of security rules. These systems can optimize traffic flow and enhance safety by using sensors, cameras, routers and cellular technology to dynamically adjust control mechanisms such as traffic lights, freeway on-ramp meters, bus rapid transit lanes, highway message boards and even speed limits. Today, Smart Traffic Management Systems make it possible to increase the capacity of city streets without actually adding new roads. With the advent of connected vehicle technology, these systems will also be able to directly control vehicles when needed — braking them in intersections, for example, to prevent accidents with pedestrians or other vehicles. Smart Cities are deploying these systems now to be prepared when the vehicle technology is fully tested and deployed.

- Objectives of Smart Traffic Management Using IOT

The main purpose of Smart Traffic Management Systems (STMS) using the Internet of Things (IoT) is to optimize traffic flow, reduce congestion and improve the safety of road users. To achieve this goal, IoT-enabled STMS relies on multiple streams and other devices that collect real-time data on traffic, road conditions, and weather. This data is then processed and analyzed to make real-time decisions to optimize traffic flow.

- Some of the specific objectives of STMS using IoT are:

Real-time traffic monitoring: One of the main objectives of STMS using IoT is real-time traffic flow monitoring. Sensors installed on traffic signals, roads and vehicles collect data about traffic flow and send it to the central system. This data is then analyzed to identify areas of congestion and other traffic problems.

Traffic Optimization: Another goal of STMS using IoT is to optimize traffic flow. Using data collected from sensors, STMS can adjust traffic signals and other road management systems to improve traffic flow and reduce congestion. For example, STMS can adjust the timing of traffic signals to reduce wait times at intersections and improve traffic flow.

Incident Management: STMS using IoT can help manage incidents such as road accidents or road closures. By collecting real-time data on road conditions and traffic flow, STMS can identify incidents and adjust traffic flow to reduce congestion.

Environment and sustainability: STMS using IoT can also help reduce the environmental impact of vehicles on the road. By collecting data on vehicle speed, fuel consumption and emissions, STMS can optimize traffic flow to reduce emissions and improve air quality.

Safety: Another goal of STMS using IoT is to improve the safety of road users. By collecting data on road conditions, weather and traffic flow, STMS can determine potential hazards and take action to prevent accidents. For example, STMS can adjust the timing of traffic signals to reduce the risk of collisions.

In general, the main objective of STMS using IoT is to optimize the traffic flow and improve the safety of road users. By collecting real-time data on traffic flow, road conditions and weather, STMS can make real-time decisions to improve traffic flow and reduce congestion. In addition, STMS can help reduce the environmental impact of vehicles on the road and improve the sustainability of the transportation system in general.

- The future of Smart Traffic Management Using IOT

The future of intelligent traffic management systems (STMS) using the Internet of Things (IoT) seems promising. As technology advances, it is expected that STMS using IoT will become more efficient, effective and widespread. Here are some ways that STMS using IoT is expected to grow in the future:

Integration with other technologies: STMS using IoT is expected to integrate with other technologies such as autonomous vehicles and 5G networks. Autonomous vehicles can communicate with STMS to optimize traffic flow and reduce congestion. The introduction of 5G technology can provide faster and more reliable data transmission, allowing STMS to respond more effectively to real-time traffic conditions.

Advanced analytics: Artificial intelligence (AI) and machine learning are expected to become more widespread in STMS using IoT. AI can analyze large amounts of data in real time, identify patterns, and make decisions to optimize traffic flow. Using AI can improve the safety of road users by identifying potential hazards and taking action to prevent accidents.

Predictive maintenance: Predictive maintenance is a technique that uses data analytics to determine when equipment needs maintenance. STMS using IoT can use predictive maintenance to determine when traffic signals and other equipment need maintenance. This can help prevent equipment failure and reduce downtime.

Improve interoperability: As more STMS are deployed, there is a need to improve interoperability between different systems. Developing standards for data exchange can improve interoperability and facilitate the collection and processing of data from different sources.

Greater emphasis on data security: As more devices connect to the Internet, the risk of cyber attacks increases. STMS using IoT must prioritize information security to prevent cyber attacks and protect individual privacy.

- Key elements for successful implementation of Smart Traffic Management Using IOT

The successful implementation of Smart Traffic Management Systems (STMS) using the Internet of Things (IoT) requires careful planning and implementation. Some of the key elements required for successful implementation of STMS using IoT are:

Infrastructure: The first key element is the infrastructure needed to support the implementation of STMS. This includes the deployment of sensors, cameras and other devices that can collect data on traffic flow, road conditions and weather. In addition, it is very important to build a communication network that can transfer data in real time.

Data Management: The second key element is data management. STMS using IoT generates a large amount of data and managing this data requires a powerful data management system. Collected data must be securely stored, analyzed and visualized to generate insights that can be used to optimize traffic and improve road safety.

Integration: The third key element is integration. Data from different sources must be integrated to optimize traffic flow and improve road safety. For example, data from sensors, traffic signals and cameras must be integrated to provide a unified view of traffic flow.

Analytics: The fourth key element is analytics. Data collected by STMS using IoT should be analyzed to generate insights that can be used to optimize traffic and improve road safety. This requires the use of advanced analytics tools such as machine learning and artificial intelligence.

Communication: The fifth key element is communication. Successful implementation of STMS using IoT requires effective communication. Communication is required between different parts of the system, such as sensors, traffic signals, and the central control system.

Public Involvement: The sixth key element is public involvement. STMS using IoT can be perceived as invasive and it is important to involve the community

to solve problems and explain the benefits of the system. This can help increase public support and reduce resistance to STMS implementation.

II. REVIEW OF LITERATURE

- Smart Traffic Management System:

When it comes to implementing IoT technologies in transport, the first goal is traffic jam problem-solving. The American Transportation Research Institute estimates that congestion costs the U.S. freight sector $74.1 billion annually. Traffic management Internet of Things solutions allows you to increase the capacity of city streets without actually adding new roads and play a vital role in the transition to smart cities.

They optimise traffic flow and keep traffic safe using sensors, cameras, routers, and cellular technologies to dynamically adjust controls such as traffic lights, highway exit counters, expressway bus lanes, highway bulletin boards, and even speed limits. These systems utilize sensors, cameras, cellular routers and automation to monitor and automatically direct traffic and reduce congestion. The right technology solution can be scaled to any size and painlessly upgraded at any time. Simultaneously, these technology solutions prepare Smart Cities for coming technology evolutions, including Connected Vehicle and the full deployment of 5G networks.

- History & Background:

The world's first IoT device was invented in the early 1980s at Carnegie Mellon University. A group of students from the university created a way to get their campus Coca-Cola vending machine to report on its contents through a network in order to save them the trek if the machine was out of Coke. They installed micro-switches into the machine to report on how many Coke cans were available and if they were cold.

In 1990, John Romkey connected a toaster to the internet for the first time. A year later, a group of students at the University of Cambridge used a web camera to report on coffee. They came up with the idea to use the first web camera prototype to monitor the amount of coffee available in their computer labs coffee pot. They did this by programming the web camera to take photos three times a minute of the coffee pot. The photos were then sent to local computers so everyone could see if there was coffee available.

- Global:

The chip shortage continues to slow the Internet of Things (IoT) market recovery, according to our latest State of IoT—Spring 2022 report, released in May 2022. The number of global IoT connections grew by 8% in 2021 to 12.2 billion active endpoints, representing significantly lower growth than in previous years.

Despite a booming demand for IoT solutions and positive sentiment in the IoT community as well as in most IoT end markets, IoT Analytics expects the chip shortage's impact on the number of connected IoT devices to last well beyond 2023. Other headwinds for IoT markets include the ongoing COVID-19 pandemic and general supply chain disruptions. In 2022, the market for the Internet of Things is expected to grow 18% to 14.4 billion active connections. It is expected that by 2025, as supply constraints ease and growth further accelerates, there will be approximately 27 billion connected IoT devices.

III. RESEARCH METHODOLOGY

- Methodology Qualitative versus Quantitative techniques

In order to satisfy the objectives of the project, quantitative research was held.

The aim is to classify features, count them, and construct statistical models in an attempt to explain what is observed.

- Data collection method and tools

The method adopted for data collection required for this research is the Survey Method and use of secondary data available. Thus, a questionnaire was prepared consisting of simple questions and was distributed among 100 respondents. The Survey Method proved to be instrumental in framing the respondent profile and also in realizing their opinions on AI in Healthcare Services

Research Technique: Descriptive Research
Method Adopted for Data Collection: Survey Method
Sample Unit: 100 respondents

- Sample Selection

There are several different sampling techniques available, and they can be subdivided into two groups: probability sampling and non-probability sampling. In probability (random) sampling, you start with a complete sampling frame of all eligible individuals from which you select your sample. In this way, all eligible individuals have a chance of being chosen for the sample, and you will be more able to generalize the results from your study. Probability sampling methods tend to be more time-consuming and expensive than non-probability sampling. In nonprobability (non-random) sampling, you do not start with a complete sampling frame, so some individuals have no chance of being selected. Consequently, you cannot estimate the effect of sampling error and there is a significant risk of ending up with a non-representative sample which produces non-generalizable results. However, non-probability sampling methods tend to be cheaper and more convenient, and they are useful for exploratory research and hypothesis generation.

- Tools of data collection

The main tool used for collecting the data for this research is the Questionnaire. The questions in the questionnaire were arranged in a logical order with personal information in the beginning followed by questions related to AI in Healthcare Services. Liker scale was used mainly while preparing the questionnaire. The questionnaires were to be filled by 100 respondents. This was done by personally asking the doctors or medical students to fill the questionnaire or was filled by interviewing customers and some of them also chose to reply to questionnaires, which were sent to them through E-mails.

Primary Sources of Data

- Direct access to respondent (Students)
- Google form

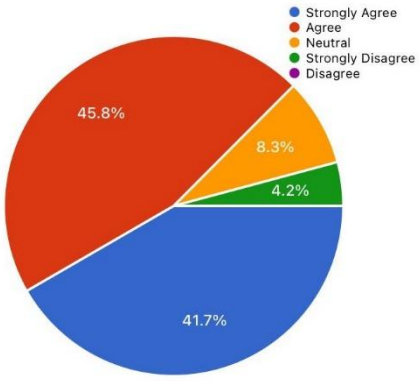
Secondary Sources of Data

- Internet websites
- Newspapers and magazine articles
- Social site
- Research journal

IV. DATA ANALYSIS

We had conducted a survey among 100 people. This survey was conducted to collect information about their understanding of SMARTTRAFFIC MANAGEMENT SYSTEM USING IOT, and we have the following findings—

Chart 4.1: Chart showing the smart traffic systems will help in smoother traffic operations.



Inference: Here 41.7% respondents strongly agreed, 45.8% respondents agreed,8.3% respondents voted neutral and 4.2% strongly disagreed

.Analysis: Here most percentage of respondents agreed and and least percentage of respondents strongly disagreed that the smart traffic systems will help in smoother traffic operations.

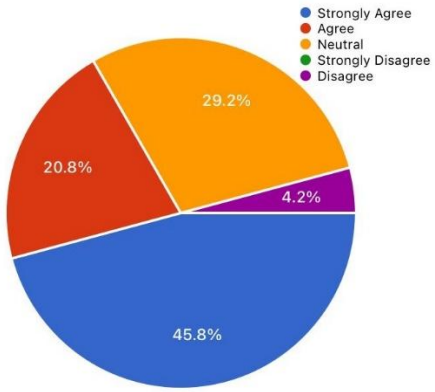
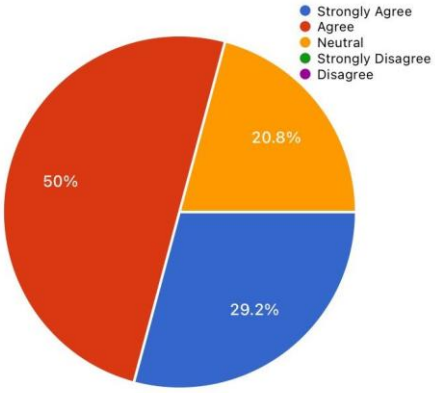


Chart 4.2: Chart showing the AI smart traffic system camera, crime rates come down by capturing through AI detection mode in Bangalore

Inference: Here 45.8% respondents strongly agreed, 20.8% respondents agreed, 29.2%

Respondents voted neutral and 4.2% disagreed.
Analysis: Here most percentage of respondents strongly agreed and least percentage of respondents disagreed that the AI smart traffic system camera, crime rates come down by capturing through AI detection mode in Bangalore

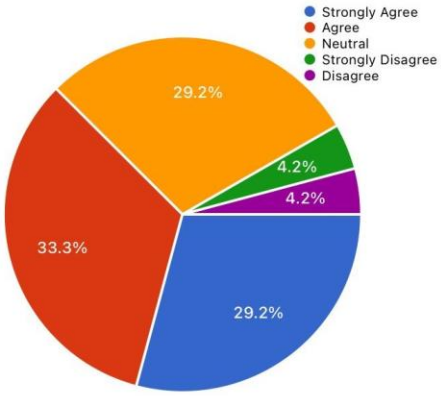
Chart 4.3: Chart showing the AI detection camera's, it can capture traffic violators easily



Inference: Here 29.2% respondents strongly agreed, 50% respondents agreed and 20.8% respondents voted as neutral.

Analysis: Here most percentage of respondents agreed and least percentage of respondents were neutral that AI detection camera's, it can capture traffic violators easily

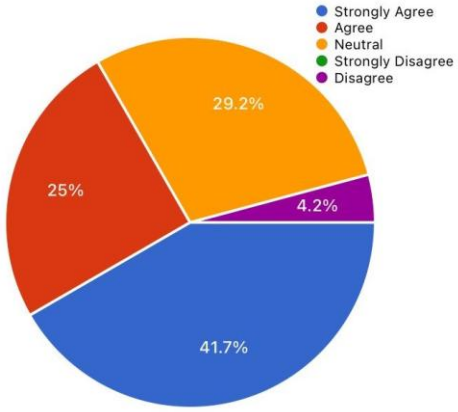
Chart 4.4: Chart showing the time to reach particular destinations at main junction road to divert traffic by getting information from cloud.



Inference: Here 29.2 % respondents strongly agreed,33.3% respondents agreed, 29.2% respondents voted as neutral, 4.2% respondents strongly disagreed and 4.2% respondents disagreed.

Analysis: Here most percentage of respondents strongly agreed as well as neutral and least percentage of respondents strongly disagreed as well as disagreed that the time to reach particular destinations at main junction road to divert traffic by getting information from cloud.

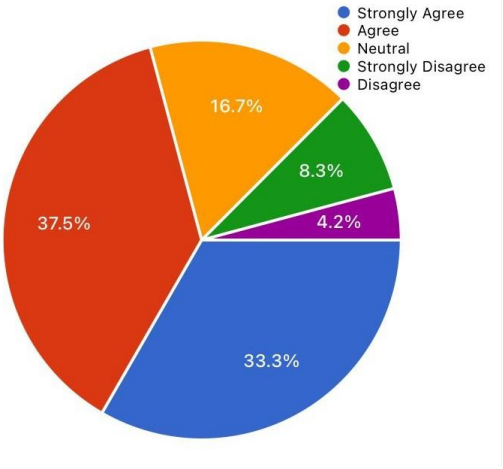
Chart 4.5Chartshowing the Smart traffic management system comes up in Bangalore city partnered up with Google maps or have a separate for it



Inference: Here 41.7% respondents strongly agreed, 25% respondents agreed, 29.2% respondents voted neutral, 4.2% respondents disagreed

Analysis: Here most percentage of respondents strongly agreed and least percentage of respondents disagreed that the Smart traffic management system comes up in Bangalore city partnered up with Google maps or have a separate for it.

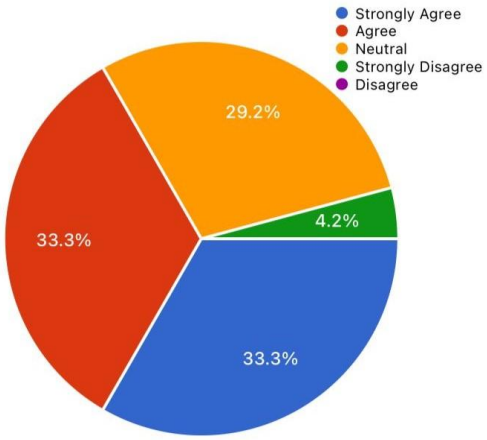
Chart 4.6: Chart showing that for daily commuters in the evenings such as corporate workers and college students would want to schedule ride timings in smart traffic management system cloud so that it could tell which route to take before hand by AI analysis



Inference: Here 33.3 % respondents strongly agreed,37.5% respondents agreed, 16.7% respondents voted as neutral, 8.3% respondents strongly disagreed and 4.2% respondents disagreed.

Analysis: Here most percentage of respondents agreed and least percentage of respondents disagreed that for daily commuters in the evenings such as corporate workers and college students would want to schedule ride timings in smart traffic management system cloud so that it could tell which route to take before hand by AI analysis.

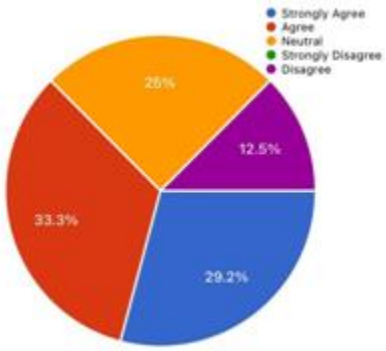
Chart 4.7Chartshowing by AI technology detection in smart traffic management cameras, it can detect major accidents and could let nearby hospitals dispatch ambulance



Inference: Here 33.3% respondents strongly agreed, 33.3% respondents agreed,29.2% respondents voted neutral and 4.2% strongly disagreed

Analysis: Here most percentage of respondents strongly agreed as well as agreed and least percentage of respondents strongly disagreed thatby AI technology detection in smart traffic management cameras, it can detect major accidents and could let near by hospitals dispatch ambulance .

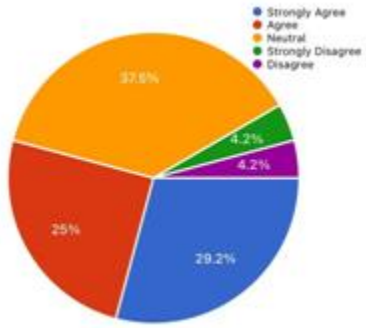
Chart 4.8: Chart showing since the evolution of 5g in India, efficiency and connectivity with smart traffic management will be smoother.



Inference: Here 29.2% respondents strongly agreed, 33.3% respondents agreed, 25% respondents voted neutral, 12.5% respondents disagreed

Analysis: Here most percentage of respondents agreed and least percentage of respondents disagreed that since the evolution of 5g in India, efficiency and connectivity with smart traffic management will be smoother.

Chart 4.9Chart indicates that the cars upcoming from 2024 will have smart sensors involved and these sensors would be connected with the Bangalore traffic cloud system and would assign routed depending on scheduling your ride



Inference: Here 29.2 % respondents strongly agreed,25% respondents agreed, 37.5% respondents voted as neutral, 4.2% respondents strongly disagreed and 4.2% respondents disagreed.

Analysis: Here most percentage of respondents were neutral and least percentage of respondents strongly disagreed as well as disagreed that the cars upcoming from 2024 will have smart sensors involved and these sensors would be connected with the Bangalore traffic cloud system and would assign routed depending on scheduling your ride.

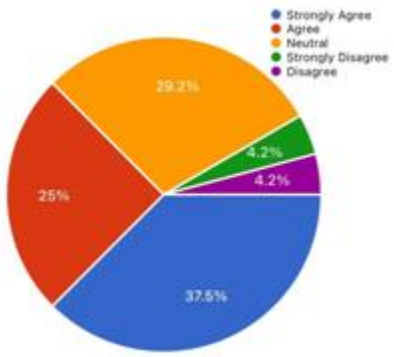


Chart 4.10: Chart showing that to know the air quality outside while taking a ride

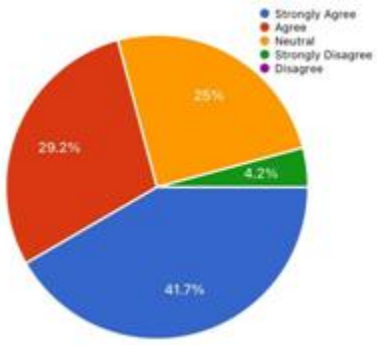
Inference: Here 37.5 % respondents strongly agreed,25% respondents agreed, 29.2% respondents voted as neutral, 4.2% respondents strongly disagreed and 4.2% respondents disagreed.

Analysis: Here most percentage of respondents strongly agreed and least percentage of respondents strongly disagreed as well as disagreed that to know the air quality outside while taking a ride.

Chart 4.11: Chart showing that by adding smart sensors in ambulance and police vehicles, it could send a distress signal for emergency and the smart traffic management system could make sure to clear the route

Inference: Here 41.7% respondents strongly agreed, 29.2% respondents agreed,25% respondents voted neutral and 4.2% strongly disagreed

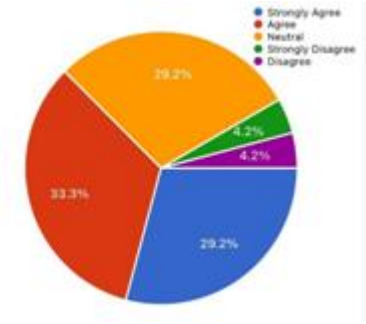
Analysis: Here most percentage of respondents strongly agreed and least percentage of respondents strongly disagreed that by adding smart sensors in ambulance and police vehicles, it could send a distress signal for emergency and the smart traffic management system could make sure to clear the route



Inference: Here 41.7% respondents strongly agreed, 29.2% respondents agreed,25% respondents voted neutral and 4.2% strongly disagreed

Analysis: Here most percentage of respondents strongly agreed and least percentage of respondents strongly disagreed that by adding smart sensors in ambulance and police vehicles , it could send a distress signal for emergency and the smart traffic management system could make sure to clear the route

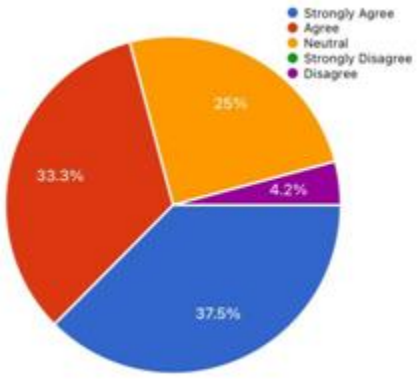
Chart 4.12: Chart showing that by adding smart sensors on vehicles it could track the driving efficiency so that it would be easier for cops to hold reckless drivers



Inference: Here 29.5 % respondents strongly agreed,33.3% respondents agreed, 29.2% respondents voted as neutral, 4.2% respondents strongly disagreed and 4.2% respondents disagreed.

Analysis: Here most percentage of respondents agreed and least percentage of respondents strongly disagreed as well as disagreed that by adding smart sensors on vehicles it could track the driving efficiency so that it would be easier for cops to hold reckless drivers

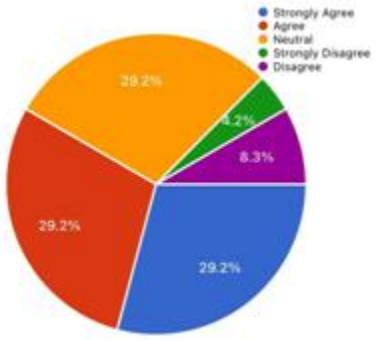
Chart 4.13: Chart showing that by opting for smart traffic management in Bangalore it would know the fuel consumption to the particular destination



Inference: Here 37.5% respondents strongly agreed, 33.3% respondents agreed, 25% respondents voted neutral, 4.2% respondents disagreed.

Analysis: Here most percentage of respondents strongly agreed and least percentage of respondents disagreed that by opting for smart traffic management in Bangalore it would know the fuel consumption to the particular destination

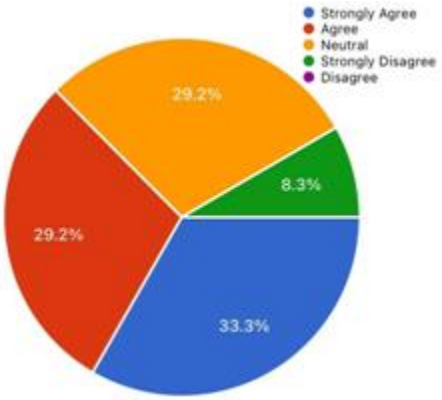
Chart 4.14: Chart showing smart traffic management system leads to less energy consumption



Inference: Here 29.2 % respondents strongly agreed,29.2% respondents agreed, 29.2% respondents voted as neutral, 4.2% respondents strongly disagreed and 8.3% respondents disagreed.

Analysis: Here most percentage of respondents strongly agreed as well as agreed as well as neutral and least percentage of respondents strongly disagreed that smart traffic management system leads to less energy consumption

Chart 4.15: Chart showing smart traffic management lead to economic growth and smoother traffic congestion



Inference: Here 33.3% respondents strongly agreed, 29.2% respondents agreed, 29.2% respondents voted neutral and 8.3% strongly disagreed.

Analysis: Here most percentage of respondents strongly agreed and least percentage of respondents strongly disagreed that smart traffic management lead to economic growth and smoother traffic congestion

CONCLUSION

In summary, the implementation of Smart Traffic Management Systems (STMS) using the Internet of Things (IoT) is a promising approach to optimize traffic flow, improve road safety and increase the stability of transportation systems. IoT-enabled STMS can collect data in real-time, analyze it using advanced analytics tools, and provide insights that can be used to optimize traffic flow, reduce congestion, and prevent accidents.

The goals of STMS using IoT include improving traffic flow, reducing congestion, improving road safety, and developing a sustainable transportation system. The future of IoT-enabled STMS will be characterized by enhanced integration with other technologies, advanced analytics, predictive maintenance, increased interoperability, and a greater focus on information security.

Key elements such as infrastructure, data management, integration, analytics, communication and social engagement must be considered to successfully implement STMS using IoT. By focusing on these key elements, it is possible to create a reliable STMS that optimizes traffic flow, improves road safety, and improves the stability of the transportation system.

Overall, STMS using IoT can transform traffic management and help create smarter cities. By harnessing the power of IoT and advanced analytics tools, it is possible to create a more efficient, safer and more inclusive transportation system.

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