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APPLICATIONS OF ARTIFICIAL INTELLIGENCE IN AGRICULTURE

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ABSTRACT :

An agricultural organization claims that the global population is growing extremely quickly. The population grows, and so does the need for food, quickly. In light of this, we must employ a variety of technology solutions to improve the convenience and effectiveness of farming. These cutting-edge technologies include deep learning, machine learning, and artificial intelligence. Many agricultural industries are using artificial intelligence technologies to increase production and efficiency. In order to provide light on a potential future in which artificial intelligence may power the agricultural sectors, this article will address how AI can alter agricultural behaviour. Additionally, it looks at the many obstacles and AI-powered concepts for the future.

Keywords: Artificial Intelligence, Artificial Neural Networks, Agriculture, Data Mining, Deep Learning, Machine learning, Robotics.

INTRODUCTION:

Long-term economic growth is significantly influenced by agriculture, which is both a significant sector and the backbone of the economy. The industry is searching for new preventive measures and ways to increase agricultural output due to a number of variables, including population expansion, climate change, and worries about food security. It places a strong emphasis on identifying damaged crops and enhancing the likelihood of productive, healthy crops. Producing, harvesting, and selling staple crops may be done more effectively with the help of artificial intelligence. Artificial intelligence is helping the agricultural industry handle data to minimise unfavourable results, and as the field grows, so does the ability of agro-based businesses to operate more profitably.

PREDICTIVE ANALYTICS

AI has enormous promise and is revolutionising agriculture in many important ways. It gives farmers access to cutting-edge technology that help them cultivate more effectively and produce more. Rain-fed farmers have a difficult time getting ready for farming since even one week without rain might ruin their crop.

Microsoft has created an AI-based Sowing App powered by Microsoft Cortana Intelligence Suite in collaboration with ICRISAT (International Crop Research Institute for Semi-Arid Tropics) to help farmers use AI's potential to boost yields [3].

The AI Sowing App leverages data on weather, soil quality, and other variables to provide farmers with recommendations on when to plant their crops through the use of robust cloud-based predictive analysis. With the use of advanced forecasting models, real-time meteorological data, and over thirty years of climate data, the app uses artificial intelligence (AI) and machine learning to predict the best times to plant, the best depth of seeding, amount of manure to use, and many other factors. Farmers are then sent this information through text messages on a feature-limited phone. . The sowing-related text messages help the farmers to increase the fertility of the soil and their productivity. In 2017, those farmers who were receiving the AI-sowing app advisory text messages had 10-30% higher yields per hectare than others [2].

III AGRICULTURAL ROBOTS

Addressing the growing global population's need for sustenance poses a significant challenge, particularly in the face of labor shortages in several nations. To overcome this obstacle, there is an urgent demand for the advancement of agricultural machinery to enhance feasibility, efficiency, and cost-effectiveness. The integration of robotics into agriculture has proven beneficial in various applications:

A. Aerial Imaging: Drones

In agriculture, the preparation of crop management plans, seasonal analysis, and assessment of fertilizers' impact require sophisticated technology. A key player in this realm is drone technology, which provides real-time, high-quality imaging. Algorithms integrated with drones aid in crop identification, progress monitoring, health assessment, and determining optimal harvest times. This technology not only reduces costs but also improves overall crop yields.

B. Autonomous Navigation: Driver-less Tractor

Driver-less tractors, equipped with self-driving capabilities, offer precision and accuracy at slow speeds. Programmed to utilize GPS and environmental observation, these tractors autonomously make decisions about speed and movement while avoiding obstacles. This technology ensures a stress-free and safer working environment for farmworkers.

C. Indoor Harvesting: Greenhouse Harvesting

Indoor harvesting, facilitated by robotics and machine vision, involves robots navigating greenhouse passages. These robots identify ripe and unripe plants and fruits using computer vision, harvest them, and transport them to the on-boarding boxing system.

D. Fruit Harvesting Robotics: Harvest CROO Robotics

Harvest CROO Robotics aims to bridge the gap between declining labor availability and increasing food demand. The robotic picker, equipped with artificial intelligence, mimics human pickers by analyzing strawberry shrubs and identifying ripe berries. This innovative solution enhances efficiency without altering traditional farming practices.

E. Spraying and Weeding Robotics: Blue River Technology

Blue River Technology is at the forefront of precision agriculture, reducing herbicide and chemical usage. Through the implementation of See & Spray machines, tractor-towed robots precisely sense and apply inputs in real-time. This technology identifies regions with weeds and applies herbicides only where needed, minimizing environmental impact.

F. Plantix App

Plantix, an AI-driven application, proves invaluable to farmers globally. By allowing users to upload pictures of crops, the app provides information on diseases, pest infestations, and nutrient deficiencies. Users receive a health diagnosis or a list of potential crop health conditions, offering essential guidance to farmers and gardeners.

CROP AND SOIL MONITORING

Deforestation and soil degradation pose significant threats to food security and the economy. Crop and Soil Monitoring, offering timely and reliable information on their status, plays a pivotal role in decision-making for improved crop production. This method efficiently identifies soil and crop defects, including nutrient deficiencies, aiding in proactive management.

Companies are leveraging computer vision and deep learning algorithms, utilizing data captured by drones, to monitor and evaluate crop and soil health. Notable agricultural apps employing computer vision include Farm at Hand and Xarvio.

A. **Farm at Hand** Farm at Hand focuses on optimizing crop yields by enabling farmers to track planting, spraying, and harvesting tasks. Real-time data collection facilitates better decision-making for improved crop yields. The app utilizes computer vision algorithms to highlight individual fields, allowing users to set seasonal plans or generate field-specific reports.

B. **Xarvio** Xarvio functions as a scouting app, empowering users to capture crop images and identify potential threats to crop health, such as diseases, pests, and weeds. Particularly beneficial for identifying region-specific diseases that lack comprehensive documentation, Xarvio's technology aids in early detection and proactive management of crop health.

These innovations in agricultural apps, driven by computer vision, offer farmers invaluable insights into crop and soil health, empowering them to make informed decisions and mitigate potential risks to crop production.

IV PEST INFESTATION

The escalating global hunger and malnutrition crises have spurred technicians to explore methodologies for pest infestation management. They're utilizing semi-automated monitoring and identification systems, employing artificial neural networks—specifically, the multilayer perceptron method—for effective pest categorization.

A novel Android mobile application is being tested by pest control technicians to aid in identifying rodents and bugs. Upon capturing an image of the pest, the technician initiates the app, powered by Google's image classification and machine learning software. The app analyzes the uploaded image to identify the pest and suggests pre-fed solutions, aiding the technician in devising an appropriate solution plan.

Notably, Wadhawani AI has developed algorithms capable of detecting significant pests that commonly affect cotton crops. Through collaborations with organizations like the Better Cotton Initiative and the Government of Maharashtra, successful field demos have been conducted, showcasing the efficacy of these pest detection algorithms.

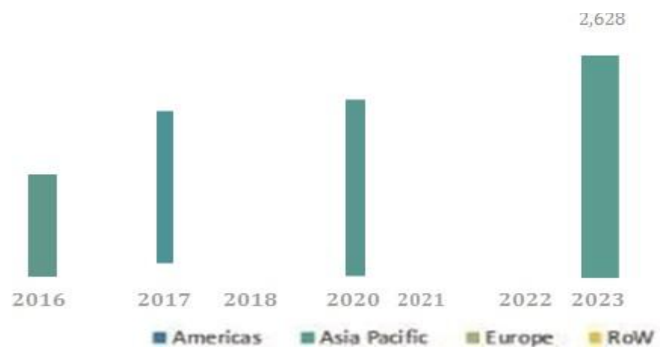
Regarding yield prediction, the culmination of various applications aimed at enhancing productivity necessitates crop cost estimation. Leveraging a blend of Internet of Things and Artificial Intelligence technologies, farmers can assess plant health and market crop prices. AI-powered equipment has shown potential to increase crop yields by around 30% with an 85% accuracy rate.

Crop yield prediction involves categorizing datasets based on productivity and class labels (low, mid, high), estimating regression and productivity ranges to predict actual crop yield costs. Empirical statistical models and data analytics techniques applied to agriculture production datasets aid in operational forecasting, providing insights crucial for farmers' decision-making.

Decision-making models, such as Support Vector Machines (SVM), have been developed for rice yield forecasting in India, utilizing methods like k-fold cross-validation. Additionally, Linear Square Support Vector Machines (LS-SVM) cater to complex datasets, aiding in crop yield estimation and guiding farmers in optimal crop selection based on available land.

The integration of descriptive analytics into agriculture has empowered farmers to cultivate healthier, more nutritious foods while minimizing grain losses, thereby increasing profits. Through AI-driven insights into pricing and yield estimation, farmers can potentially double their gains while optimizing input.

VI.ARTIFICIAL INTELLIGENCE IN AGRICULTURAL M A R K E T AI IN AGRICULTURE MARKET BY REGION (USO D- MILLION)



AI technologies incorporating machine learning, computer vision, and predictive analytics have garnered immense popularity within agricultural applications. The utilization of AI-driven equipment, supported by computer vision, has notably boosted crop production by approximately 30%, enabling highly accurate predictions of weekly and seasonal yields, often exceeding 90% accuracy (Source: Farmer's Weekly Magazine).

In the Asia Pacific region, several factors contribute to the burgeoning growth of AI in agriculture. The widespread adoption of precision farming practices aimed at enhancing crop yields, the implementation of drone analytics methods, and the increasing integration of agricultural robots are pivotal factors. Countries such as Australia, China, Japan, and India are witnessing a significant surge in the adoption of machine learning, deep learning, computer vision, and predictive analytics technologies among farmers.

VII.CHALLENGES

Artificial Intelligence offers numerous opportunities in agriculture, yet its widespread adoption faces limitations. Merely 30% of the global population is acquainted with high-tech solutions based on machine learning, deep learning, and artificial intelligence [13]. The primary hurdle for the remaining populace lies in underdeveloped IT infrastructures, hindering access to these advancements.

Challenges persist in training machines with extensive data for precise predictions, particularly due to farming's susceptibility to external factors like weather and soil conditions. Strategies that seem effective might falter when external conditions fluctuate. Gathering spatial data is feasible, but temporal data, critical for understanding crop growth, is difficult to collect as it's typically available only once a year during the growing season. Additionally, existing systems often lack accuracy and response time, necessitating improvements in handling and evaluating vast data sets. Defined methodologies for training and maintenance are essential for enhancing accuracy and speed [11].

While robots and autonomous devices hold promise in agriculture, their implementation is still in its infancy. Many robotic farming activities remain in the prototype phase, and the field as a whole requires investment and time to surpass the performance of current technologies [13]. Advancements in this domain are evolving and demand further investment and refinement to outperform existing agricultural technologies.

VIII.CONCLUSION

The global population is projected to surpass nine billion by 2050, requiring a staggering 70% increase in agricultural production to meet escalating demands. Achieving this heightened productivity hinges on intensifying current production methods, necessitating the widespread adoption of advanced high-tech solutions to enhance farming efficiency [11].

An array of applications and technologies, such as autonomous vehicles, mobile apps, and predictive tools, has been developed to streamline farming activities. However, despite the availability of certain applications, comprehensive large-scale research is ongoing, signifying that farming is still in its early stages concerning autonomous decision-making and predictive solutions. These applications need to evolve to handle dynamic external conditions, facilitate real-time decision-making, and efficiently collect data [6].

Crucially, these solutions must become more potent and resilient to address practical challenges faced in agriculture. Their adaptability to fluctuating conditions, capability for real-time decision-making, and efficiency in data collection remain paramount. Moreover, making these solutions affordable is imperative to enable widespread adoption among farmers, fostering higher productivity.

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METHODOLOGY

In the proposed work, a sophisticated method for vehicle following and an accident warning system were employed to track the getaway car using GPS and GSM technology. This system switches to rest mode while the vehicle operated by the owner or authorized person still operates in dynamic mode, the mode of operation being changed in person or remotely. If an accident occurs, the air pack's press button connected to it recognizes a sign and sends an SMS to the microcontroller. The authority notifies the owner of the vehicle or any designated party of the accident with the vehicle.

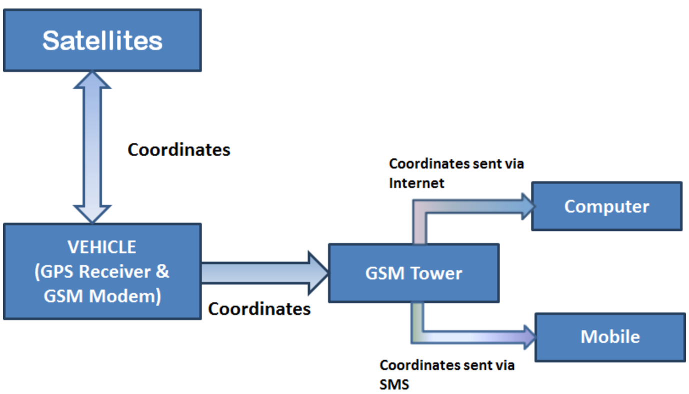


Fig.3.1: Block Diagram of Vehicle Tracking System

MAJOR COMPONENTS USED:

- ATMEGA 8 AVR
- Parallax GPS Receiver Module
- SIM 800
- PUSH BUTTON
- POWER SUPPLY

In the proposed work, a sophisticated method for vehicle following and an accident warning system were employed to track the getaway car using GPS and GSM technology. This system switches to rest mode while the vehicle operated by the owner or authorized person still operates in dynamic mode, the mode of operation being changed in person or remotely. If an accident occurs, the air pack's press button connected to it recognizes a sign and sends an SMS to the microcontroller. The authority notifies the owner of the vehicle or any designated party of the accident with the vehicle.

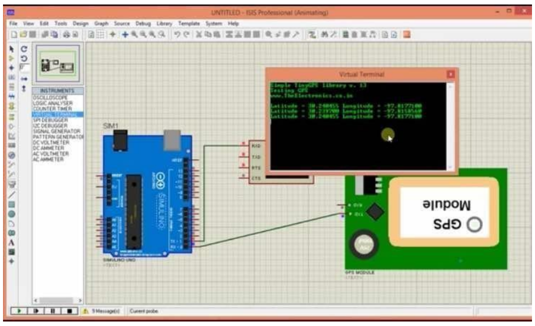


Fig.3.2: Simulation of a VTAA system using Proteus software

MICROCONTROLLER

The Atmel®AVR® ATmega8 microcontroller used in this study is a low-power CMOS 8-bit microcontroller based on AVR RISC engineering. The ATmega8 achieves throughputs approaching 1MIPS per MHz by following strict rules in a single clock cycle, enabling the system designed to increase power efficiency rather than processing performance.

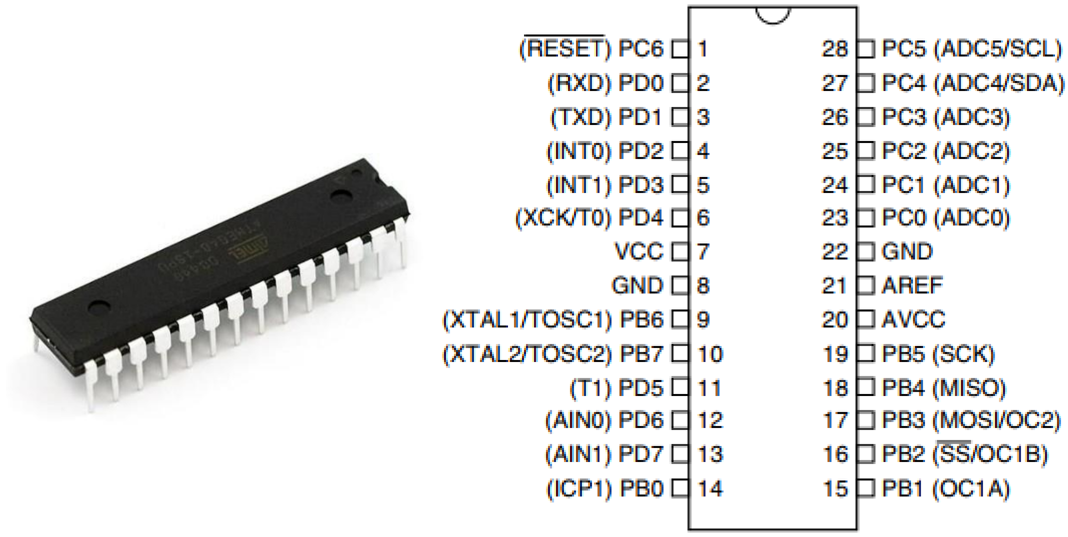


Fig. 3.2 pin diagram of microcontroller ATMEGA 8 (Atmel, 2013)

ATMEGA 8 Pin Descriptions VCC: Digital supply voltage.

GND: Ground.

Port B (PB7..PB0) XTAL1/XTAL2/TOSC1/ TOSC2: 8-bit bidirectional I/O port Port B has inner draw up resistors that are specifically chosen for each piece. Even driving qualities with large sink and source capacities are present in the Port B yield supports. Port B sticks that are remotely pulled low will source current if the draw up resistors are activated, according to information sources. Regardless of whether the clock is operating or not, the Port B pins are tri-expressed when a reset state becomes dynamic. Port C (PC5...PC0): Seven-piece, bidirectional Port C has internal draw-up resistors that are specifically chosen for each component. The Port C result backs even driving characteristics with both high source and sink capacity. Port C pins that are remotely pulled low will source current if the draw up resistors are started, according to this information. Whether or not the clock is running, the Port C pins are tri-expressed when a reset condition becomes dynamic.

In the unlikely event that the RSTDISBL Wire is modified, PC6 is used as an I/O pin. Keep in mind that PC6's electrical characteristics differ from those of the various Port C pins. PC6 is used as a Reset input in case the RSTDISBL Circuit is changed. Regardless of whether the clock is not running, a low level on this pin for a longer period of time than the base heartbeat length will result in a Reset. Port D (PD7...PD0) is an 8-cycle bi-directional I/O port with internal pull-up resistors that are specifically chosen for each component. The result cradles for Port D even have driving characteristics with high capacity sources and sinks. If the draw up resistors are started, remotely pulled low Port D pins will source current as information sources. Whether or whether the clock is running, the Port D pins are tri-expressed when a reset state becomes dynamic.

Testing, ANalysis of Result and Discussion

Hardware Assembling and Testing:

Making a transition board design for the circuit diagram was the first action conducted. Following that, the accompanying advancements were then made.

1. Put every component on the transition board together according to the circuit diagram, connect the GSM modem's TX and RX pins to pins 13 and 14 of the MAX 232, and insert a sizable SIM into the GSM modem.
2. Attach the GPS module as shown on the circuit diagram.
3. The project was successfully carried out and tried.
4. For owners of vehicles, this structure is incredibly beneficial and secure.

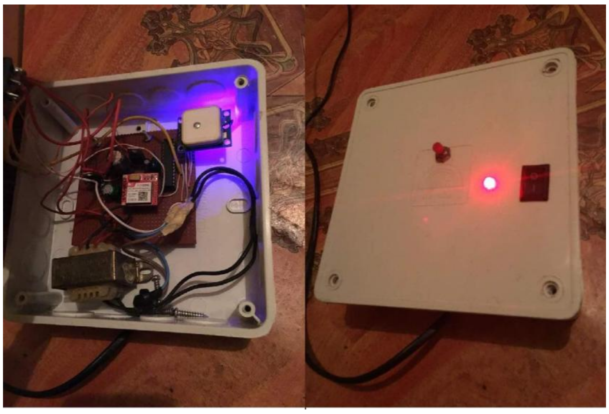


Fig 4.1: view of project during testing and evaluation

RESULTS

I have integrated a component that will send SMS to the client upon request to enable checking the location of the vehicle in the event of an accident or vehicle theft. The value of the vehicle's latitude and longitude will be put into SMS. The SMS also includes a link that enables the customer to view the location using Google Maps.

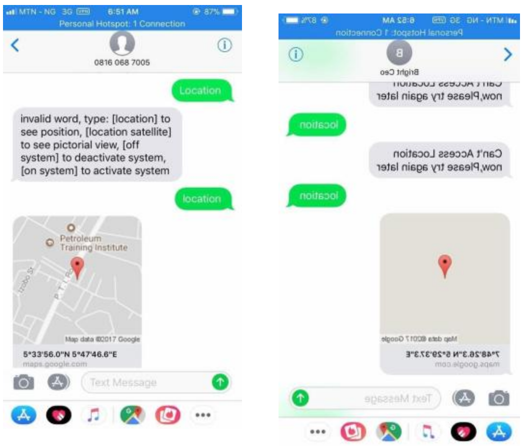


Fig 4.2: view of communication between user and VTAA system via text message

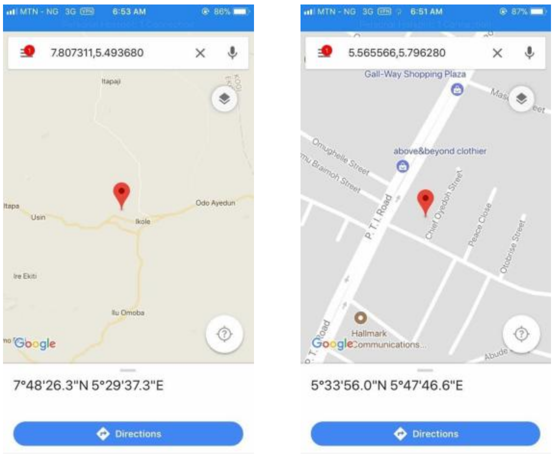
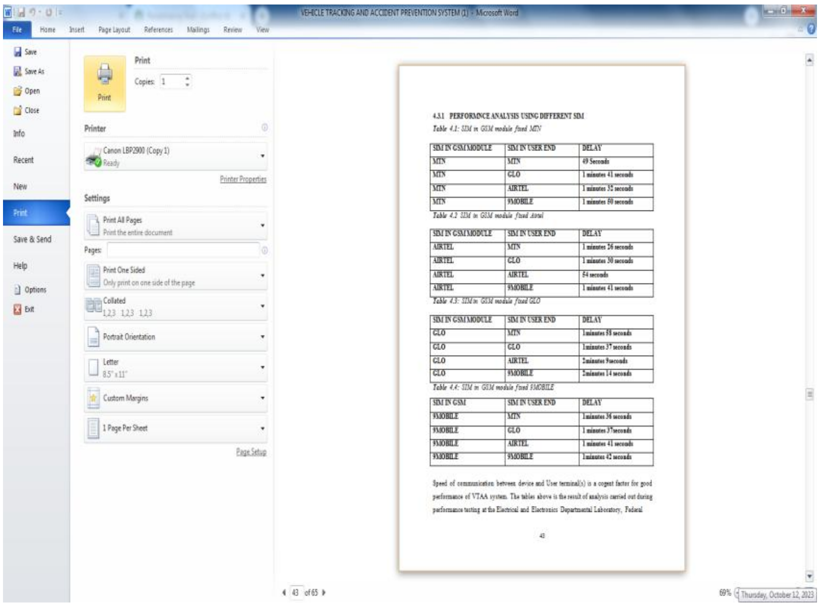


Fig 4.3: View of location on website through Google map

PERFORMANCE EVALUATION

I evaluated the entire plan of action while keeping an eye on the delayed evaluation. It is how long I saw the in-vehicle device taking to answer or send an SMS, keeping the end user in mind. We used the SIM cards 6555556UU of four different directors to create this impression of the delay evaluation. The deferral for each set of linked SIM cards was then recorded. We have used SIM cards from MTN, 9MOBILE, Glo, and Airtel, which are four different providers. It is done to keep track of different data game strategies, and regular time is meant to focus on the concede test. The table below displays the outcomes.



4.3.1 PERFORMNCE ANALYSIS USING DIFFERENT SIM

Table 4.1: SIM in GSM module fixed MTN

SIM IN GSM MODULE	SIM IN USER END	DELAY
MTN	MTN	49 Seconds
MTN	GLO	1 minutes 41 seconds
MTN	AIRTEL	1 minutes 32 seconds
MTN	9MOBILE	1 minutes 50 seconds

Table 4.2 SIM in GSM module fixed Airtel

SIM IN GSM MODULE	SIM IN USER END	DELAY
AIRTEL	MTN	1 minutes 26 seconds
AIRTEL	GLO	1 minutes 30 seconds
AIRTEL	AIRTEL	54 seconds
AIRTEL	9MOBILE	1 minutes 41 seconds

Table 4.3: SIM in GSM module fixed GLO

SIM IN GSM MODULE	SIM IN USER END	DELAY
GLO	MTN	1minutes 58 seconds
GLO	GLO	1minutes 37 seconds
GLO	AIRTEL	2minutes 9seconds
GLO	9MOBILE	2minutes 14 seconds

Table 4.4: SIM in GSM module fixed 9MOBILE

SIM IN GSM	SIM IN USER END	DELAY
9MOBILE	MTN	1minutes 36 seconds
9MOBILE	GLO	1 minutes 37seconds
9MOBILE	AIRTEL	1 minutes 41 seconds
9MOBILE	9MOBILE	1minutes 42 seconds

Speed of communication between device and User terminal(s) is a cogent factor for good performance of VTAA system. The tables above is the result of analysis carried out during performance testing at the Electrical and Electronics Departmental Laboratory, Federal

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I tested the complete course of action while observing the delayed assessment. With the end user in mind, it is how long I saw the in-vehicle device taking to respond or send an SMS. To construct this impression of the delay assessment, we used the SIM cards 6555556UU of four unique directors. We then recorded the deferral for each pair of linked SIM cards. The four distinct head SIM cards we have used are MTN, 9MOBILE, Glo, and Airtel.
One of the causes of this delay is that this GSM-based innovation's network dependence on the GSM expert co-op occurs when the vehicle travels through certain regions with poor organization inclusion. According to the analysis done above, each arrangement of information from different administrators has a delay of around 1.5 to 2 minutes, which seems less significant. seconds). Accordingly, MTN network specialist co-op was used in the project's sending and receiving terminals. For instance, correspondence in the form of a Short Message Service (SMS) is made between two MTN specialist organizations, one in the Client terminal (GSM framework) and the other in the device (VTAA framework).

CONCLUSIONS

Vehicle GPS devices have a number of benefits and enhance executives. We can accomplish more in the time we have available if we have better scheduling or course planning. When a personal or professional event occurs, vehicle following enhances safety and security, communication, execution monitoring, and effectiveness. As a result, throughout the course of the upcoming year, assumptions will substantially shift in our day-to-day lives. The main goal of the accident-ready framework project is to reduce the likelihood that someone would die in an accident that is out of our control. When an accident is suspected, paramedics are dispatched to the scene to increase the chances of survival. Accidents that occur during odd hours will benefit far more from this invention. in areas that are desolate. In the future, this vehicle-following and accident-prepared component will be considerably more common in daily life. In my concept, I've created a precise, adaptive architecture for global vehicle placement. After creating the GSM modem, I experimented with and used the GPS system to track the location of the vehicle online and by SMS. display a Google Map of the situation I've utilized the Google map programming interface. The microcontroller is the system's brain because the GSM modem is constrained by AT directives that allow information transmission via the GSM network and the GPS gives location information. Google Map displays the area whenever the GPS receives new information, which causes the data set to be refreshed The system provides accurate information continuously, enabling the client to track the car and enabling an early recovery in the event that the vehicle is stolen. My understanding of GPS has greatly increased thanks to this proposal, which has also helped me improve my programming skills.

LIMITATIONS

While this state-of-the-art technology-based global positioning system can benefit clients, organizations, or any association, there are some limitations to using this vehicle GPS beacons.

Frequently GPS finds opportunity to interface with the organization because of unfortunate atmospheric conditions. For the GPS to work appropriately, it necessities to have an unmistakable perspective on the sky. That is all there is to it is probably not going to work indoor or may try and have issue outside where it has no make way of sending to and getting signal from satellites. Accordingly, because of obstructions like tall structures or such infrastructure which block view of the sky, often causes multipath error to the getting sign of the GPS beneficiary. Accordingly, area appears to seem to bounce starting with one spot then onto the next prompting off base outcomes. Consequently wrong upsides of scope and longitude are shipped off the server, for showing in the Google map on mistake being instated.

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