DESCRIPTION

1. Title of the Invention:

Internet of Things (IoT) Based Attendance System for Road-Side Construction Sites

2. Field of Invention and use of the Invention:

The field of invention is in the adaption of Internet of Things for developing a real-time attendance monitoring system for field workers.

An IoT based attendance system is invented, which provides the benefit of monitoring the attendance of the road-side workers and their health condition. This invention is aimed at providing an affordable PCB design which mimics like a low-cost smart watch for road-side workers to get their attendance details which in-turn provides traceability of the road-side workers in a dedicated communication network.

The invention could be used to monitor the attendance and health of workers or individuals who are required to work in remote or hazardous locations such as construction sites, mines, or oil rigs. The system would use GPS technology to track the location of these workers and ensure that they are safe and accounted for at all times.

In addition to tracking attendance and location, the system could also be equipped with sensors to monitor the health and safety of workers. For example, the system could detect elevated levels of carbon monoxide or other hazardous gases and alert workers to evacuate the area.

Overall, a GPS attendance and health monitoring system for roadside units could have a wide range of applications in transportation, public safety, and industrial settings, improving safety and efficiency of road-side workers and also the general public.

3. Novelty of the Invention

The novelty of a GPS attendance and health monitoring system for roadside units lies in its ability to combine GPS technology with health monitoring sensors to create a comprehensive safety system for workers and individuals working in remote or hazardous locations.

While GPS technology is widely used in tracking the location of vehicles and individuals, the integration of health monitoring sensors represents a new and innovative approach to ensure the safety of workers in the field. By providing real-time monitoring of factors such as air quality, temperature, and other environmental conditions, the system can detect and alert workers to potential hazards before they become a danger.

In addition, the system's ability to track attendance and location provides an added layer of safety and security for workers, ensuring that they are accounted for at all times and that their whereabouts can be quickly determined in the event of an emergency.

Overall, the combination of GPS technology and health monitoring sensors in a single system represents a novel and innovative approach to ensuring the safety of workers and individuals in remote or hazardous locations.

4. Background of the Invention:

The idea of using GPS technology for tracking and monitoring purposes has been around for many years, and it has been widely used in various industries, including transportation, logistics, and fleet management. However, the application of GPS technology for attendance and health monitoring in remote or hazardous locations is a relatively new concept.

In recent years, there has been a growing concern for the safety and well-being of workers in remote or hazardous locations, such as construction sites, mines, and oil rigs. These environments are often exposed to various hazards such as hazardous gases, extreme temperatures, and other environmental factors that can put workers' health and safety at risk.

To address these concerns, researchers and companies have been exploring the use of GPS technology to track and monitor workers' attendance and health in real-time. These systems use GPS technology to track the location of workers and can be equipped with sensors that measure various environmental factors, such as air quality, temperature, and humidity. The data collected by these sensors can be used to detect potential hazards and alert workers to take necessary precautions.

The development of the GPS attendance and health monitoring system for roadside units builds on this existing research and technology. The system aims to provide a comprehensive safety solution for workers and individuals in remote or hazardous locations by combining GPS technology with health monitoring sensors. This innovation has the potential to revolutionize the way workers' safety and well-being are monitored and managed in various industries.

Site Attendance Management System (Patent No. WO 2016015090A1)

Preferably the geolocation means is a GPS device and the attendance of the user at the site is confirmed by a GPS reading from the GPS device. Alternatively, the attendance of the user at the site is triggered by a GPS reading from the GPS device. Attendance at the site may also triggered by a Bluetooth beacon or NFC device.

The user application may also register departure of the user from the site with the server device. The user may trigger registering their departure from the site via the user application. Alternatively, the user application may register departure of the user from the site when the geolocation means indicates that the user device is no longer present at the site. Preferably the user application prompts the user to confirm their departure from the site.

Health monitoring system (Patent No. US 8684922B2)

A monitoring system for a person includes a processor coupled to one or more wireless nodes; a wearable mobile appliance in communication with the client and one or more wireless nodes; and one or more computer implemented agents with rules executed by the processor, the rules being selected to respond to a client communication relating to a predetermined health condition, each agent communicating with another computer implemented agent, the client or the treatment professional, and upon receiving a communication from the client, the processor selecting one or more computer implemented agents to reply with an instruction on healthy client behaviour.

In another aspect, a heart monitoring system for a person includes one or more wireless nodes; and a wearable appliance in communication with the one or more wireless nodes, the appliance continuously monitoring patient vital signs or other data such as cardiac abnormalities. Embodiments can monitor heart rate, heart rate variability, respiratory rate, fluid status, posture and activity.

Drawbacks of Existing state-of-art and how the invention addresses the drawbacks

Limited accuracy: Manual attendance tracking can be inaccurate, as it relies on workers to sign in and out, which can be prone to errors and fraud

Delayed response: Periodic health checks only provide a snapshot of workers' health at a specific time, which means that potential hazards may go undetected until the next check-up.

Limited coverage: Traditional methods may not cover all workers in a remote or hazardous location, as workers may be working in different areas or at different times.

4.1. Objectives of the Invention:

Improve safety: The primary objective of the invention is to improve the safety of workers and individuals in remote or hazardous locations. By using GPS technology and health monitoring sensors, the system aims to detect potential hazards in real-time and alert workers to take necessary precautions to avoid accidents or health risks.

Increase efficiency: The invention aims to increase the efficiency of monitoring and managing workers in remote or hazardous locations. By providing real-time attendance and health monitoring data, the system can enable quicker decision-making, which can help to reduce downtime and increase productivity.

Reduce costs: The system aims to reduce the costs associated with traditional methods of attendance and health monitoring, such as manual tracking and periodic health checks. By providing a more comprehensive and real-time monitoring solution, the system can help to

reduce the risk of accidents and health risks, which can lead to reduced costs associated with worker compensation and medical expenses.

Provide real-time data: The invention aims to provide real-time data on workers' attendance and health, which can be used to improve decision-making and planning. The data can also be used to generate reports and analytics, which can be used to identify patterns and trends in worker behaviour and environmental factors.

4.2. Summary of the Invention:

The GPS attendance and health monitoring system for roadside units is a novel invention that combines GPS technology with health monitoring sensors to provide a comprehensive and real-time monitoring solution for workers in remote or hazardous locations. The system aims to improve safety, increase efficiency, reduce costs, and provide real-time data for monitoring and managing workers.

The system tracks workers' attendance in real-time using GPS technology, ensuring that all workers are accounted for at all times. It is also equipped with health monitoring sensors that measure various environmental factors such as air quality, temperature, and humidity. This real-time data is transmitted to a central monitoring station, where it can be analysed and used to detect potential hazards and alert workers to take necessary precautions.

The GPS attendance and health monitoring system for roadside units addresses the drawbacks of existing state-of-art methods, such as limited accuracy, delayed response, and limited coverage, by providing a more accurate, responsive, and comprehensive solution for monitoring workers in remote or hazardous locations.

Overall, the GPS attendance and health monitoring system for roadside units is an innovative solution that has the potential to revolutionize the way workers' safety and well-being are monitored and managed in various industries.

Brief description of Figures and Flow charts

Figure 1. High Level System Architecture describing the flow of data and processes

Figure 2. Circuit Diagram of the Invention depicts different types of connections across the components

Figure 3. Google Map shows the real-time attendance status of the employee

4.3. Detailed Description of the Invention:

The GPS attendance and health monitoring system for roadside units is a comprehensive and real-time monitoring solution for workers in remote or hazardous locations. The system combines GPS technology with health monitoring sensors to provide a more accurate, responsive, and comprehensive solution for monitoring workers

4.3.1. GPS Attendance for Road Side Units

The GPS attendance system for roadside units is a novel invention that utilizes GPS technology to track workers' attendance in real-time. The system is designed to provide a comprehensive and accurate solution for monitoring workers in remote or hazardous locations, where traditional methods of attendance tracking may be difficult or unreliable.

The GPS attendance system consists of several components, including a GPS tracking device, a central monitoring station, and a software application. The GPS tracking device is installed on each worker's equipment, such as a helmet or vest, and is used to track their location and movement in real-time. The central monitoring station receives data from the GPS tracking devices and uses the software application to analyse the data and generate attendance reports.

To use the system, each worker is provided with a unique identification tag, such as an RFID or barcode, which is scanned by the GPS tracking device when they arrive at the work site. The GPS tracking device records the worker's location and sends the data to the central monitoring station, where it is used to generate a real-time attendance report. If a worker leaves the work site, the GPS tracking device will detect this and update the attendance report accordingly.

The GPS attendance system provides several benefits over traditional methods of attendance tracking. Firstly, it provides real-time data on workers' attendance, which can be used to ensure that all workers are accounted for at all times. This is especially important in remote or hazardous locations where workers may be at a higher risk of accidents or health risks.

Secondly, the GPS attendance system is more accurate than traditional methods, such as manual sign-in sheets or punch cards. The system relies on the GPS tracking device to record workers' attendance, which is more reliable and less prone to errors or fraud.

Thirdly, the GPS attendance system provides a more efficient solution for monitoring workers. The system automatically generates attendance reports, which can be accessed in real-time by supervisors and managers. This can help to reduce the administrative burden associated with traditional methods of attendance tracking, such as manual record-keeping.

Overall, the GPS attendance system for roadside units is an innovative solution that has the potential to revolutionize the way workers' attendance is tracked and managed in various industries. It provides a more accurate, efficient, and real-time solution for monitoring workers in remote or hazardous locations, improving their safety and well-being.

4.3.2. Health Monitoring System for Road Side Employees

The health monitoring system for road side employees is an innovative solution that aims to improve the safety and well-being of workers in remote or hazardous locations. The system uses health monitoring sensors to measure various environmental factors such as air quality,

temperature, and humidity, as well as physiological parameters such as heart rate, blood pressure, and oxygen saturation.

The system consists of three main components: the health monitoring sensors, the data transmission system, and the central monitoring station. The health monitoring sensors are attached to the workers' clothing or worn as a wearable device, and they continuously measure the environmental and physiological parameters.

The data transmission system uses wireless communication technology such as Bluetooth or Wi-Fi to transmit the real-time data from the health monitoring sensors to the central monitoring station. The data is then processed and analyzed using algorithms and machine learning techniques to detect potential hazards and alert workers to take necessary precautions.

The central monitoring station is responsible for receiving and analyzing the real-time data from the health monitoring sensors. It uses advanced analytics tools to identify patterns and trends in the data, which can be used to detect potential hazards and provide insights into workers' health and well-being.

The health monitoring sensors measure various environmental factors such as air quality, temperature, and humidity, which can have a significant impact on workers' health and well-being. For example, high levels of air pollution or extreme temperatures can cause respiratory problems or heat stroke, which can be life-threatening. By monitoring these environmental factors in real-time, the system can detect potential hazards and alert workers to take necessary precautions, such as wearing protective equipment or taking breaks in a shaded area.

The system also measures physiological parameters such as heart rate, blood pressure, and oxygen saturation, which can provide insights into workers' health and well-being. Abnormal readings in these parameters can indicate potential health problems such as hypertension or respiratory distress, which can be addressed in a timely manner to prevent serious complications.

Overall, the health monitoring system for road side employees is an innovative solution that has the potential to revolutionize the way workers' safety and well-being are monitored and managed in various industries. By providing real-time data on environmental and physiological parameters, the system can detect potential hazards and alert workers to take necessary precautions, improving their safety and well-being. The system can also provide insights into workers' health and well-being, which can be used to inform decision-making and improve the overall health and productivity of the workforce.

4.3.3. Mathematical Model for IoT based Attendance System:

4.3.3.1. Distance Calculation:

Let (lat1, lon1) and (lat2, lon2) be the two roadside units' latitude and longitude coordinates. The distance between them can be calculated using the Haversine formula:

$$d = R * 2 * \arcsin\left(\sqrt{sin^2\left(\frac{\theta}{2}\right) + cos\,\emptyset_1 * \ cos\,\emptyset_2 * \ sin^2\left(\frac{\Delta\lambda}{2}\right)}\right) \quad (1)$$

where,

R - The Earth's radius (e.g., 6371 km).

θ - The difference in latitudes in radians.

φ_1 and φ_2 - The latitudes of the two units in radians.

$\Delta\lambda$- The difference in longitudes in radians.

Algorithm :

1. Start the algorithm.
2. Initialize the Earth's radius, R, to 6371 kilometers.
3. Accept the latitude and longitude values for the first point, lat1 and lon1, respectively.
4. Accept the latitude and longitude values for the second point, lat2 and lon2, respectively.
5. Convert the latitude and longitude values of both points from degrees to radians.
   lat1_rad = math.radians(lat1)
   lon1_rad = math.radians(lon1)
   lat2_rad = math.radians(lat2)
   lon2_rad = math.radians(lon2)
6. Calculate the differences in latitude and longitude.
   dlat = lat2_rad - lat1_rad
   dlon = lon2_rad - lon1_rad
7. Apply the Haversine formula.
   a = math.sin(dlat/2)**2 + math.cos(lat1_rad) * math.cos(lat2_rad) * math.sin(dlon/2)**2
   c = 2 * math.atan2(math.sqrt(a), math.sqrt(1-a))
8. Calculate the distance using the formula distance = R * c.
9. Return the distance.
10. End the algorithm.

4.3.3.2. Time Calculation:

Let t1 and t2 be the timestamps when two roadside units are visited, respectively.

The time difference can be calculated as the absolute difference between the two timestamps.

$$\Delta t = |t_2 - t_1| \qquad (2)$$

t_1 and t_2 - The timestamps of the two visits.

Δt - The time difference in seconds

Algorithm:

1. Start the algorithm.
2. Accept the two datetime objects, t1 and t2, as inputs.
3. Calculate the absolute difference between t2 and t1.
   diff = abs(t2 - t1)
4. Convert the time difference to seconds.
   diff_seconds = diff.total_seconds()
5. Return the time difference in seconds.
6. End the algorithm

4.3.3.3. Attendance Calculation:

Let d_threshold be a distance threshold and t_threshold be a time threshold for considering two visits as attendance.

If the distance between two units is less than or equal to d_threshold and the time difference is less than or equal to t_threshold, we consider it as attendance.

Define a function to check attendance based on the distance and time thresholds:

$$attendance = \begin{cases} 1, if\ distance\ \leq\ d_{threshold} \\ 0, otherwise \end{cases}$$

attendance - The attendance status (1 for attendance, 0 for no attendance).

$distance$ - The calculated distance between the two units.

$d_{threshold}$ - The distance threshold

If the attendance status is 1, it means that the units are considered attending. Otherwise, they are not considered to attend.

Algorithm:

1. Start the algorithm.
2. Accept the latitude and longitude values for the first location, lat1 and lon1, respectively.
3. Accept the timestamp for the first location, t1.
4. Accept the latitude and longitude values for the second location, lat2 and lon2, respectively.
5. Accept the timestamp for the second location, t2.
6. Accept the distance threshold, d_threshold, and the time threshold, t_threshold.
7. Calculate the distance between the two locations using the haversine function: distance = haversine (lat1, lon1, lat2, lon2)
8. Calculate the time difference between the two timestamps using the time_difference function: time_diff = time_difference (t1, t2)
9. Check if the distance is less than or equal to the distance threshold and the time difference is less than or equal to the time threshold.
10. If both conditions are met, return True, indicating that the attendance is valid.
11. Otherwise, return False, indicating that the attendance is not valid.
12. End the algorithm.