European Journal of Molecular & Clinical Medicine
ISSN 2515-8260 Volume 7, Issue 4, 2020

INTELLIGENT ACCIDENT TRACKING SYSTEM USING RASPBERRY PI

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Abstract. Everyone in today's world possesses a vehicle to avail a comfortable journey, making most of the chores gratified. As the result of this the number of vehicles on road has increased in a tremendous amount in the last decade. Along with this the number of accidents has also increased thus causing a large amount of death mainly because of rash driving and few other human errors. With the outbreak of large number of death caused by accidents many measures have been taken like limiting the maximum speed of vehicles, restricting the movements of heavy load vehicles during the day and many more. But till today the practice or measures taken on preventing the accidents is given more priority compared to ,the precautions taken to cure a victim who met with an accident. The existing methodologies to treat /support a victim are very few and also are not that reliable .This paper thus proposes a method where in, a person who met with an accident is assured a fast support from the ambulance operating in the nearby location. This is achieved by sending the precise site of the mishap to the already available helpline numbers using recent technologies.

1. Introduction

The number of vehicles per person is increasing at fast rate along with leading to many road accidents, especially those with four wheelers. Almost all of the deaths occurring in a road accident are due to the lack of immediate medical assistance, mostly the highways. Therefore, any kind of medical facility available at accident prone areas would reduce the mortality rate drastically.

Even though there are a few devices and techniques already available to alert the respective departments during any such incidents, the efficiency of these systems is not precise to make it a 100 percent reliable. The result of which there is an occurrence of death due to lack of timely first aid/treatment. This paper is providing a solution to such a case where the victim is provided with immediate support from the nearest hospital or ambulance service.

This is achieved by the use of GPS and GSM Modules, which track the exact location of the vehicle when an accident occurs. The location is taken from the spot where the accident occurs through the crash sensor that will be attached to the front of the vehicle. The front portion of the car i.e. the bonnet will have the first point of impact during any accident in moving vehicles. Therefore placing the sensor in the rim of the bonnet is the most desirable choice. Some of the vehicle which has air bag safety mechanism uses this crash sensor for sensing any impact on the car and to blow up the air bags to avoid collision of the passenger within the cars body. Using the same, we are going to trigger yet another circuit which will capture the location of the place where the accident occurs. The Crash Sensor is connected to Raspberry Pi3 which can detect the accident and transmit the signal to the GSM and GPS module which will send the exact location as a message to the selected contacts. The location being accurate, the ambulance service can get to the spot immediately to save the victims from further suffering. The camera module interfaced with the Raspberry Pi 3 will help us to record the day to day travel and helps to find the clear problem that occurred at the state of accident time, which would be helpful to find the offender.

2. Literature Survey

[1] explains the idea of tracking and monitoring the Vehicle movement to enhance the safety and security of the driver. The GPRS sends the location to the server and the GSM sends the alert messages to selected contacts .If a small accident has occurred and there is no harm to anyone's life, then there is the option for the alert message to be cancelled by the driver or any other near peoples by a switch in order to avoid the message to control and save time. To Develop and improve the overall rescue process, a quick and exact estimation of the severity of the accident system offered perfect facts to emergency services as soon as possible and saves life [2]. In recording information about the vehicle much before and during the accident by using a black box is presented. The real time statistics collected are analyzed and additionally the facts are transmitted over the wireless network for alerting purposes [3]. There must be a monitoring unit to detect accident, thus CBITS is used. CBITS is a highly effective, real-time, light weight, reliable, low-power consuming and a cost effective system for the vehicle-owners as well as the monitoring authorities [4].Vehicle tracking system uses the GSM and GPS module with locking system. The work includes GPS, GSM modules. The framework also detects Alcohol consumption and Engine Temperature, All the values can be seen on the Sob page and organized to extract out the word force of the vehicle body.

3. Proposed System

An automatic accident detector is implemented in the new system with the intention of subduing the downfall in the existing system. The vehicle's inbuilt sensor, GSM, GPS senses the condition around and forwards the location to the main server unit consisting the registered phone number. An ambulance equipped with monitoring vitals of the patient rushes him to the hospital while simultaneously transfers these details to the nearest hospital, hence using time efficiently.

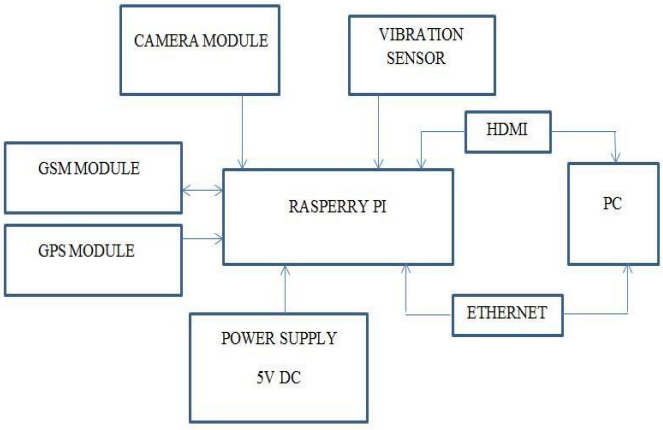

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Fig 1: Block diagram

4. Architecture of Proposed System

The system comprises of GPS, GMS, vibration sensor and a raspberry pi 3 module. This system also requires mobile network SIM which will be connected in GSM where the location details from GPS will be stored and this will be sent as a message to the selected contacts. When an accident occurs, the location i.e. the latitude and longitude is captured from the accident spot with the use of the sim which is linked to Google maps.

Accident detection system- The systems' primary module is the crash detecting unit, here referred to the vibrating sensor. The vehicle, during the crash mainly will get hit in the front part compared to the other sides of the vehicle. So the vibrating sensor which plays a major part here is supposed to be placed in the bonnet of the vehicle. This vibrating sensor receives its signals as input from the pre-existing crash sensor in the vehicles. The crash sensor is the one that is employed for the air bag system in the

vehicles. Similar to the air bag mechanism where the air bags are blown up immediately when an accident occurs, this system performs its action. So when the crash is detected and the air is blown up, simultaneously the location is also captured with the help of the module and sent to the pre-registered mobile number in the system. For that vehicle that does not have an air bag mechanism, this system can be installed too.

Apart from the vibrating sensor, there is also a camera module that is interfaced with the raspberry pi 3 module. This is the key strength of the system, where the video recorded can be viewed to find the exact reason for the accident. This can be done by connecting the raspberry pi module to a monitor or a laptop.in case of a laptop there are certain software that has to be installed for the effective working and viewing if the recorded video.

The interfacing process requires connecting the Raspberry pi 3 board with external devices to access it, namely keyboard, mouse and a monitor. Both the keyboard and mouse can be connected to RPi 3 board using the USB type cables. The monitor requires a HDMI to HDMI cable or a HDMI to VGA cable converter which connects to the peripheral devices to access it. In condition of using the Laptop with the RPi 3 board, it requires Ethernet cable and few softwares to be installed and accessed. The Laptop must consist of Advanced IP scanner, Putty software,VNC viewer, and Xming.

The Xming is set ON, these protocols are all used to run a remote session on a computer, over a network. It executes the client end of that session, the end where the session is displayed, rather than the end where it runs. Using the Advanced IP scanner the IP of the raspberry pi will be checked to be configured and the IP is noted. Using Putty, the IP address and port will be noted to operate the RPi 3 board. Clicking open takes us to command prompt or terminal where the login and password will be required to link the system and RPi board's link to access in the same monitor. Then to access the IP in same monitor VNC viewer is used to bridge two IP's, were the command is given in the command prompt to get an IP to access it. Using the VNC viewer, the RPi 3 board is made to operate in an IP in our own monitor using the IP generated using Putty software. While using by Laptop, it requires this process where, when using external devices it can be hot plugged and accessed and operated.

5. Design Of Accident Detecting System

Raspberry Pi 3 B+:

Dual-band wireless LAN and the Bluetooth are provided by the Cypress CYW43455 chip, connected to a Pro ant PCB antenna similar to the one used on Raspberry Pi Zero .When comparing with the previous one, Raspberry Pi 3B+ delivers slightly better performance in the 2.4GHz band, and Good performance in the 5GHz band. The RPi 3 board is displayed in the Fig below .The specs of Raspberry pi 3 B+ are as follows:

1.1.

1. **SOC**: Broadcom BCM2837B0, Cortex-A53 (ARMv8)64-bit
2. **CPU**: 1.4GHz 64-bit quad-core ARM Cortex-A53CPU
3. **RAM**: 1GB LPDDR2SDRAM
4. **WIFI**: wireless LAN Dual-band (2.4GHz and 5GHz) and Bluetooth
5. **Ethernet**: Gigabit Ethernet over USB 2.0 (max 300 Mbps). Power-over-Ethernet support (with separate PoE HAT). Improved PXE network and USB mass-storage booting.
6. **Thermal management**: Available
7. **Video**: Full-size HDMI
8. **Audio**: Available
9. **USB** : 4USB 2.0 ports
10. **GPIO**:40 pins in total
11. **Power**: DC power input Range-5V/2.5A

12. **Operating system support**: Supports Unix and Linux

The pin out diagram of the Raspberry pi 3 B+ board is given below which makes us know detailed purpose of using and external devices that can be connected with the Raspberry pi 3

Fig 2: Rpi Module

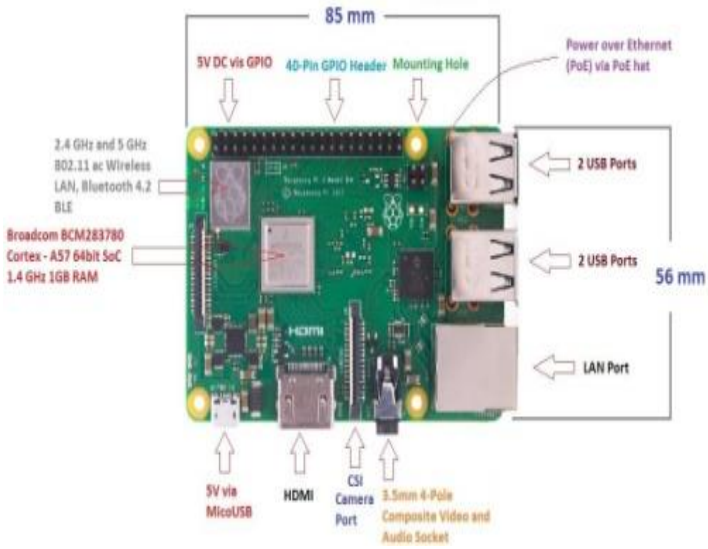

Fig 3: Pin Out Diagram Rpi

GPS Module:

GPS is a space-based satellite route framework. It gives area and time data in every single weather condition, anyplace on or close to the Earth. GPS collectors are prevalently utilized for route, situating, time spread and other examination purposes.

Fig 4: Gps Module

Neo - 6M GPS module appeared in beneath sends us the scope and longitude subtleties of the area where the GPS beneficiary module is put. Based on Ublox NEO-6M GPS receiver, the specifications and key points to note are, in an open sky area, it takes within 5 seconds to hot start and send the location details. When we use in a closed area or place with less signals to connect and start it takes more time and send location information.

GSM Module:

SIM900A GSM module is a mobile communicating device which could send messages and call mobile for communications. Since RPi consists only one UART connection pin RS232 to USB converter cable is used to transfer the data from GSM to RPi board and configured and transferred. The SIM900A GSM

Module is been displayed in the below Fig 5. The specifications of SIM900A GSM module are:

- **Single supply voltage**: 3.40V –4.50V
- **Power saving mode**: The power usage in SLEEP mode is1.5mA
- **Frequency bands**:SIM900A Dual-band: EGSM900, DCS1800. The SIM900A is capable to look through 2 frequency bands at the same time naturally
- **DATA GPRS**: max download transfer is 85.60Kbps, max Upload transfer 42.80Kbps
- Supports single SIM card

Fig 5: GSM Module

Vibration Sensor:
The Vibration Sensor (SW-420) is a high sensitivity non-directional vibration sensor. Whenever the module is stable, the circuit is turned on and the output is high. Whenever a vibration or movement occurs, the circuit will be temporarily disconnected and the output will be low. The sensitivity can be adjusted according to your own needs. It consists of three pins where Vcc must be given with 5V DC, ground pin and D0 pin to one of the GPIO pins of RPi board to get the vibrated value or input.

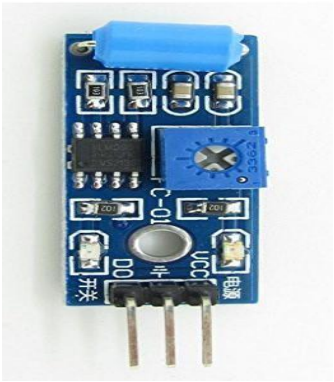

Fig 6: Vibration Sensor

The specification of the SW-420 Vibration Sensor is shown in the above Fig.6

- **Operating voltage:** 3.3V /5V
- **Interface:** Digital

- **Weight:** 4.3g

The external vibration is the input signal for the vibration sensor (SW-420) and its output is digital signal. That digital signal is given to the Raspberry Pi 3 B+ board as input to the GPIO pin, so that it performs to execute our process and complete it. At the point when the development or vibration happens the circuit will be disconnected temporarily and output is low.

Raspberry Pi Camera Module:

Raspberry Pi Camera Module of 5MP resolution is been interfaced to the CSI camera port in the RPi 3 board and it can be used to both capture images and to record videos. The specification and abilities of the camera module are:

- **Video Resolution:** 2592 x1944
- **Video:** can record 1080p @30fps,720p @ 60 fps
- **Recording:** 640 x 480p60/90
- **15-pin MIPI Camera Serial Interface** – can be plugged or connected in the raspberry pi module.

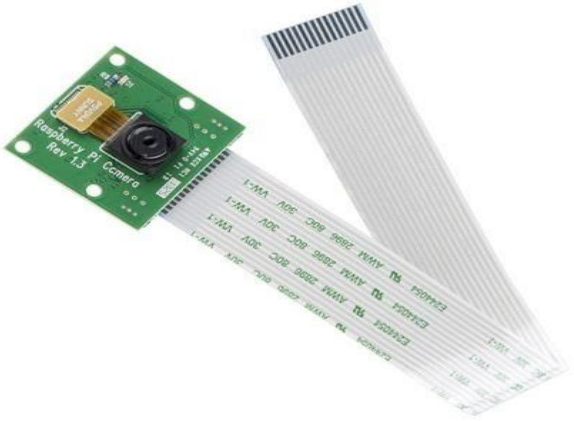

Fig 7: Camera Module

The sensor has a fixed resolution of 5 mp(megapixel) and has a fixed focus lens connected. In case of static images, the camera is capable of 2592 x 1944 pixel static images, and also capable of 1080p30FPS, 720p60FPS and 640x480p60/90 video. No Connectors required. This camera can be connected directly into the Raspberry Pi 3 Model B camera port. This Raspberry Pi Camera Module in the above Fig is a custom designed add-on for Raspberry Pi. It interfaces with Raspberry Pi in a method of one of the two little attachments on the board upper surface. This interface uses the dedicated CSI interface on board, which was designed especially for interfacing to cameras. The CSI bus can carry high data rates, and it exclusively carries pixel data.

PIN Connections:

- GPIO pins 18 and 27 are given as ON and OFFswitches.
- Camera module connected in the CSI camera port of the RPiboard.
- RPi pin 10 (Rx) Tx pin of GPS module, RPi pin 6 (Ground) Ground of GPS,and RPi pin of 1 (Vcc-3.3V) Vcc of GPSmodule.
- Since UART pins of RPi board is connected to GPS module, GSM also a UARTdriven device. So, RS232 to USB converter is used to transfer data between GSM and RPi3.
- GPIO pin of RPi 17 is given to D0 pin of Vibration sensor and 5V supply is given bythe RPi pin 2(Vcc-5V) and RPi Ground to Ground Pin of Sensor.

- GSM module is powered by 5V DC charger, since it has voltage regulator in it, ittakes its required voltage of 3.4 – 4.5V. The connections are done and made to function.

6. Experiment and Simulation Setup

Step 1:

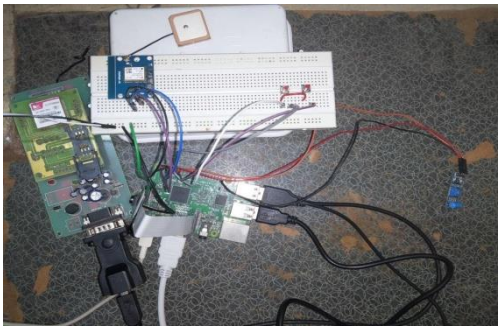

Fig 8: Powering the components

The connections are done as the above Fig 8.The circuit is checked for proper functioning via the LED Indicators and then the Program is saved to the device.

Step 2:

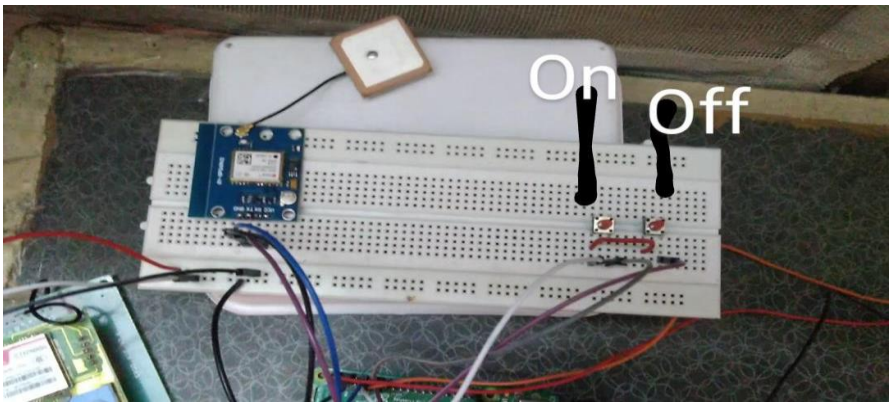

Fig 9: GPIO – input signals

The above Fig 9 shows a simple car on/off switch connected to the GPIO pin 17, a push in this button causes the program to begin its execution which further starts the recording via the camera module continuously .If in any case an accident occurs .the device is configured to share the location to the contacts which is shown in fig 10.

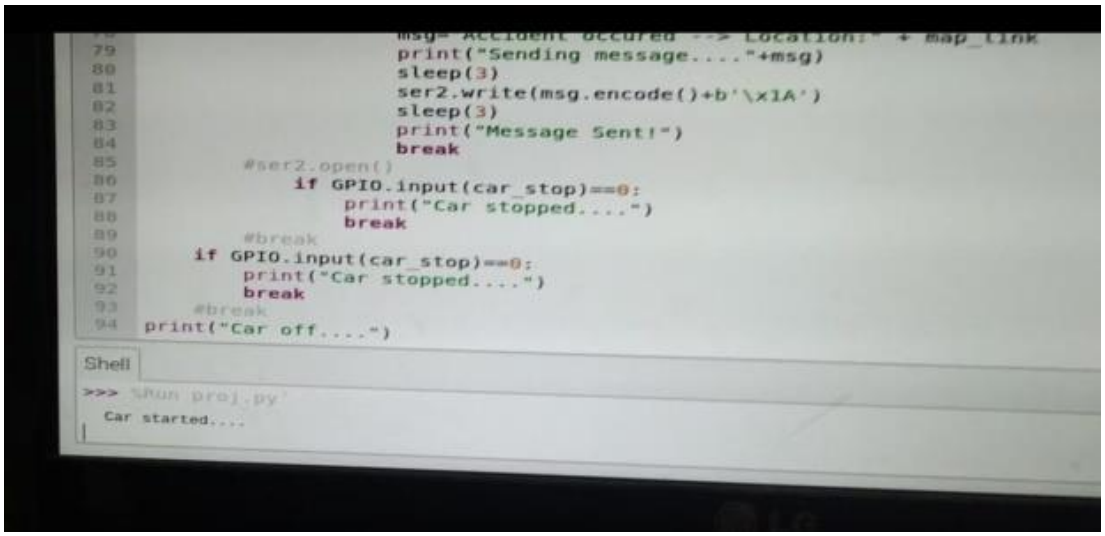

Fig 10: Working example

Step 3:

From Fig 11, the Vibration Sensor detects for accident .When it is activated it sends the signal to the RPi 3 Board to access the GPS and GSM modules and thus send the location details to the selected contacts.

Fig 11: Vibration Sensor

Step 4:

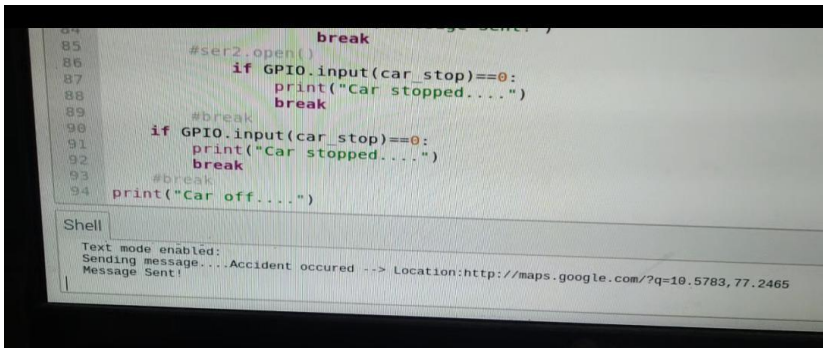

Fig 12: GSM Module Working

Since the accident is detected, vibration sensor sends the signal to the RPi board as the location details is found by the Neo 6-M GPS module and it is sent by the GSM module to the selected contacts

7. Results and Analysis

This proposed system will detect if the accident has occurred and if yes, it will trace the exact location of the area were the accident has taken place. The images proving the above proposed system are displayed below. When the crash is detected the vibration sensor sends a signal to the board to get connected to the GPS module. This when triggered during the accident, captures the location of the vehicle and is then transmitted to a contact number that is already registered, mostly ambulance or control centers. Apart from this the camera module that is attached will also get activated and the video of the accident will get stored in the memory card .this further allows us to vie the actual reason of the accident.

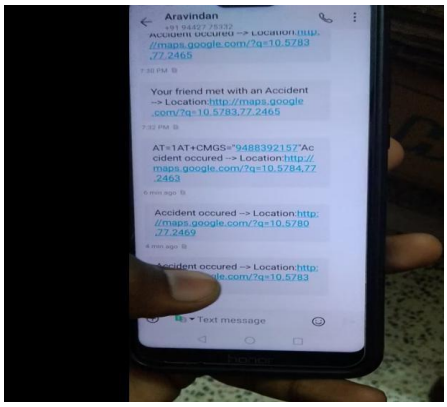

Fig 13: Message recieved

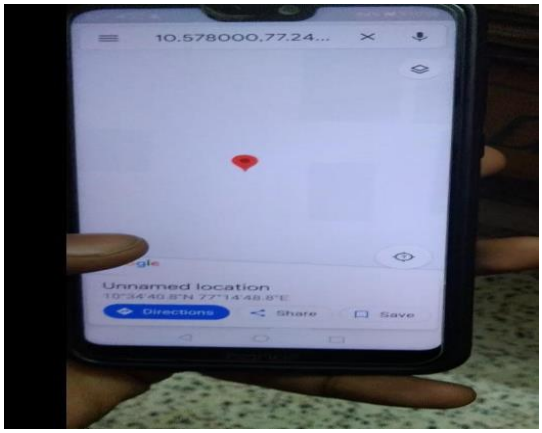

Fig 14: Getting exact location

The recorded footage will be stored in the memory card of the RPi as the Fig. 14 and could be viewed for security purposes and so on. The video recorded can be played and viewed as shown in the Fig 15.

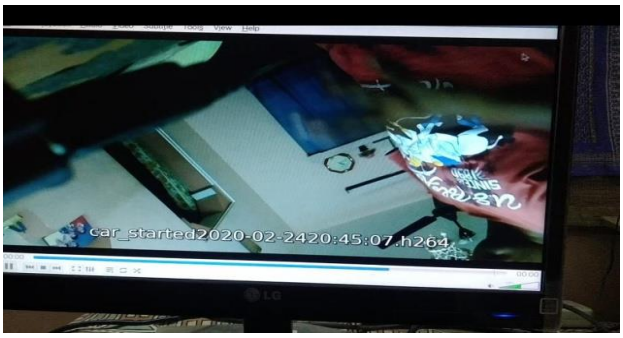

Fig 15: Displaying the footage

8. Conclusion

This paper showcases the development in the hardware of a vehicle's tracking system. The GSM modem is used to track the vehicle's GPS coordinate and transmit them to the registered mobile. This tracking system features real-time tracking which can be used for various purposes like, security of an individual vehicle, public transportation systems, fleet management and many others apart from medical emergency usage. It provides an improved adaptability and worldwide operability. The reliability of the system can be altered for better performance along with additional features, thus improving efficiency. Once complete, the system can likely be commercialized as an independent standalone product due to its utility and efficacy.

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