Solar Ambulance and utilities for Physically Challenged Persons

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ABSTRACT
A country like India receives huge amount of solar energy equivalent to some trillions of kWh/year, which is far more than the total energy consumption of the country. But solar energy is being used in India mostly for heating water & few lighting purposes. In order to promote its usage, Indian Renewable Energy Development Agency and the Ministry of Non-Conventional Energy Sources are formulating a programme to have solar energy in more than a million applications in the next few years. This project is a sincere attempt to join them. This project gives us another perspective for the effective utilisation of this energy to the maximum extent, using the solar panel tilting mechanism, and storing the same in a battery. In turn, the same energy is used to drive the ambulance to the hospital. Along with this, patient's body temperature is monitored and transmitted to the hospital unit with the help of the transmitter. In addition to the above features, this project provides a utility for patients who cannot walk, by providing musical tone which motivates them to walk and helps in stimulating the nerve cells. An intelligent blind stick is another feature which helps blind people.

General Terms
Transmitter, receiver, microcontroller, relays, DC motor, LDR, decoder, encoder, temperature sensors

Keywords: **Solar tracking system, auto panel tilting Mechanism, solar panels**

1. INTRODUCTION
Renewable Energy is the wave of the future. These sources are available in abundant and can be continuously regenerated thus giving solution to energy problems. This project is utilizing one such source of energy called solar energy, arriving from 51% of sunlight which actually enters the Earth's atmosphere. Solar radiation provides 170 million GW of power. According to photovoltaic systems this generation of energy is millions of times greater than the maximum power demand of all mankind. Both the forms of solar energy namely Passive & Active offer the opportunity to access this tremendous energy source. Passive solar energy is harnessed with the use of building orientation as well as selecting materials with the effective thermal properties that collect and distribute energy.

Active solar energy is created through the use of solar photovoltaic cells present in the solar panel which directly converts solar radiation into electricity or thermal energy for radiant heating.

Solar ambulance is a vehicle powered by solar energy. Here the required energy is obtained from solar panels placed on the surface of the vehicle. These solar panels consist of Photovoltaic (PV) cells, which convert the energy from the sun directly into electrical energy. PV cells directly convert sunlight into electricity. When sunlight (photons) strikes PV cells, they excite electrons and allow them to flow, creating an electrical current. PV cells are made of semiconductor materials such as silicon and alloys of indium, gallium and nitrogen. Silicon is the most common material used in PV cells and has an efficiency rate of 15-20% [1].The fluctuation in the amount of sunlight that arrives at the earth's surface, the time of day, time of year and weather conditions affect production and must be considered for proper application. Hence in order to overcome the above limitation, solar panel is fitted on the vehicle that uses, 'Auto tilting mechanism' which shows proportional movement according to the maximum sunlight. This is achieved by using the LDR (Light Dependent Resistor) fitted at both the ends of solar panel and movement of the panel is done using motor which is fitted at the bottom of the panel. In addition to this, patient's body temperature is also measured in the vehicle itself using thermistor. This project is incorporated with another feature of automatic gate control and this is done using RF transmitter in the ambulance which is used to send the data to RF receiver which is at the hospital side. ATMEL 89C51 microcontroller has been made use of, to open the gate at the hospital. This project has even included light indication system at the reception in the hospital about the vehicle arrival.

Another interesting part of this project is that it has few of the utilities for patients, like walking plate stimulator which helps the patient to recover from walking disabilities. It has plates and whenever patient places their foot on these plates it generates various kinds of colors which is done using push buttons and are placed at the bottom of the plate and colors are indicated using LED's. Along with the generation of colors we have designed such that even musical tones are generated which acts as motivating factor for the patients to walk. Another utility is for the blind person that provides intelligent blind stick used to alert the blind person and avoids the accidents.

2. SYSTEM ARRANGEMENT
The arrangement of the components of this project are described in following sections

2.1 Solar ambulance
Initially the sunlight is sensed with help of the LDR sensing circuit and the signals from the sensing circuit is given to the tracking system as shown in fig.1.

Solar tracking system is constructed using motor and gear mechanism so that panel is tilted according to the sunlight.

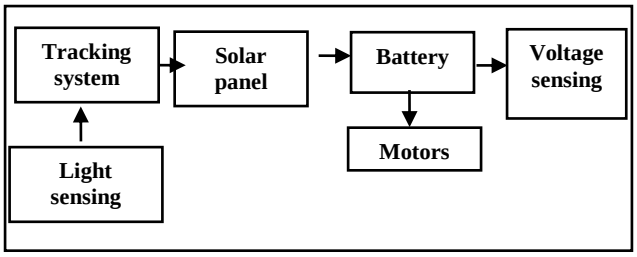

Figure 1. Block Diagram representing required components for solar ambulance

From the solar panel it is given to the 12 volts lead acid battery for the energy storage and from the battery it is given to the motors to drive the vehicle in the hospital unit. The motors that are used here are having capacity 12 volts with heavy torque.
Further the voltage present at the battery is sensed using the zener diode switching circuits which helps in driving the vehicle.

2.2 Transmitter and Receiver section

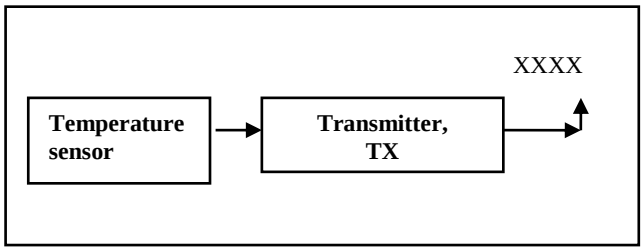

Figure.2 Block Diagram representing required components for temperature monitoring in the ambulance

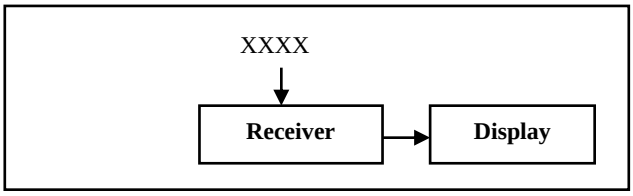

Figure.3 Block Diagram representing required components at the hospital for data acquisition from the patient

One more arrangement made in this system is to sense the body temperature of patient and send it to hospital. The arrangement for that system is also shown in the block diagram of fig.3. The recording is done as follows: The sensor is used to sense the respiration of the patient and transmit the data to the hospital. The transmitter works at 433MHZ.The data is encoded and sent through the transmitter. The receiver is placed at the hospital, which detects the same and display.

2.2 Walking plate stimulator

Additionally, this project has some utilities for the challenged patients. Figure.4 shows the block diagram representation of walking plate stimulator. The system shown here it is a method to create an interest by generating, a different colours of lights with different tones so that the person themselves create an interest. The mechanical pressure switch closes when the person put the foot on the plate as soon as the mechanical switch goes to close the relay circuit comes in to action & starts switching on colour light

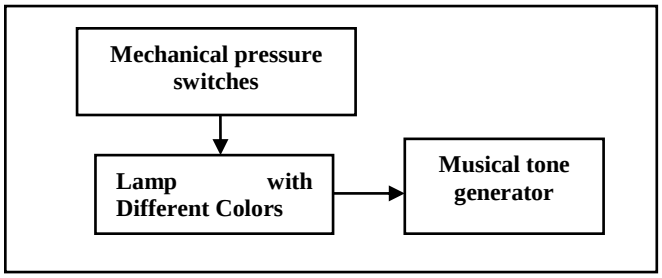

Figure.4 Block diagram representing the required components for walking plate stimulator

A signal has been provided to a melody tone generator IC so it has to start generating a tone which is further amplified & given to speaker to emit the tone The same arrangement is given to all the plates so that different colors are possible to generate so that to create an interest with walking.

2.4 Intelligent Blind Stick

2.4.1 Arrangement at vehicle

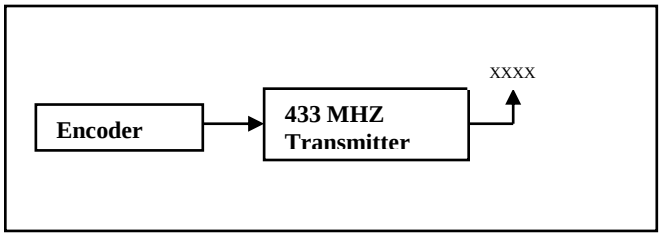

Figure.5 Block diagram representing required arrangement in the travelling vehicle

2.4.2 Arrangement at stand point of the vehicle

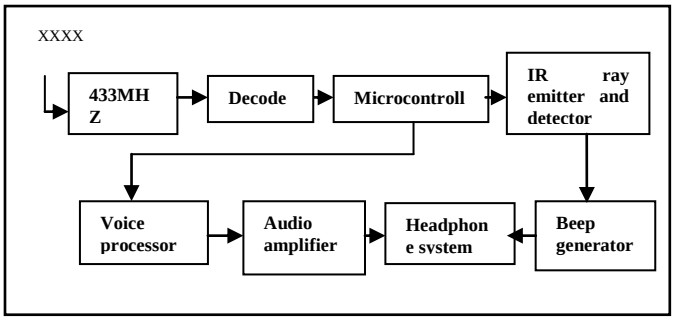

Figure.6 Block diagram representing required components for alerting the blind patient.

For assisting for blind person to identify bus stop as well as buses the figure.6 shows the arrangement. The basic working of such a system is based on RFID technique and a suitable interfacing of 89c51microcontroller. The system described here is consisting of encoded transmitters and receivers which are placed in bus stops and buses inside. The encoder generates binary data in the serial fashion into the ASK HT 12D transmitter (amplitude shift keying). Each transmitter either in bus stop or bus inside generates its own coding data. The system is arranged such that each bus stop and each bus will be identified with its own coding number. The coded data will be sent to ASK transmitter as an input. When such a binary data is

fed to transmitter because of shift keying method the binary data is sent in the form of RF waves at a frequency of 433MHZ. The RF frequency is radiated in the atmosphere and whenever it is in contact with receiver this data is received in the form of RF signals, because here the receiver is also tuned for the same frequency of transmitter. The receiver is fitted with the blind person unit. When data from receiver is received in the form of binary, the output is in terms of serial data, as this data is required to be converted in terms of parallel. This is done through once again with decoder. The decoder converts the binary data into its parallel format. The decoded output is same as that of encoded data, the unique code is assigned for the particular bus stop or bus. If the blind unit interacts with the unit of bus the data which is assigned for the particular bus has been decoded in blind person unit and this data has been fed to micro controller. The micro controller is programmed in such a way that the output drives the voice processor unit. The voice processor unit is so designed that the pre-recorded voice data regarding the particular bus name and routes is announced through the audio amplifier unit to a head phone system. If another bus of other route came for the same bus stop the assigned code for this bus is different from pervious bus so the data received at blind person unit is different. Because of this reason the micro controller unit triggers the voice data which is actually the name and bus route of second bus. The same process is repeated for different busses also. If the blind person is inside the bus and he want to get down for his bus stop in this case the same process takes place and from blind person unit the voice processor announces the particular name of the bus stop. But here the data received in blind person unit is the same data which is assigned for particular bus stop. The voice processor used here is type of flash memory which can be possible to rewrite for so many times.

The blind person can be given with extra safety like detection of obstacles on the road with the technique of sending and receiving IR beams. In the blind person stick the IR and photodiode combination is specially arranged that they are continuously generating the signals at the frequency of around 8 kHz through IC timer 555. When the signals are targeted front and if there is abstractions there is no photo signal on photodiode and it does not saturate. When any abstraction placed in between then the IR beam will fall on the photodiode and the timer output go high which starts generating the beep sound this is now connected to ear phone of the blind person and they get the information and can change the direction. This provides the security against any accidents.

3. HARDWARE DETAILS

3.1Solar tracking system

In order to utilize solar light to maximum extent following system has been developed. Figure 7 shows the circuit diagram for solar tracking system used in solar panels. The system is designed using LDR (Light Dependent Resistor), 555 timers operated in the monostable and astable multivibrator modes, relays (6v) for switching, bridge rectifier, ICL293 (motor driver and controller), bidirectional DC motor, electrolytic capacitors, diodes (IN4007) and variable resistors (presets).The IC1 and IC2 are operated in the monostable mode.

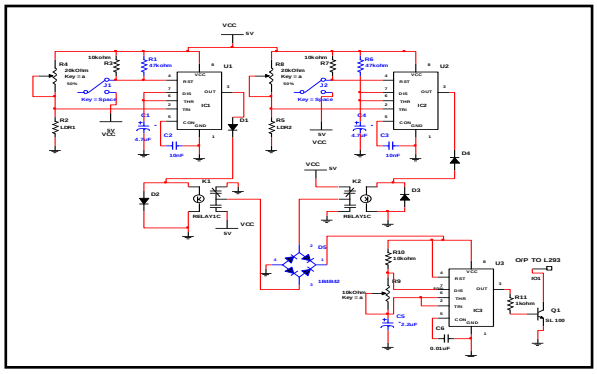

Figure.7 Circuit diagram for solar tracking system

The IC3 is operated in the astable mode. The two LDR's 1 and 2 are connected to the IC1 and IC2 respectively and positioned to the two extreme ends of the solar panel, so that only one LDR receives the sun rays and the other receives the shadow. Only one LDR conducts at a time. When the sun rays are from east to west the LDR1 gets the light and starts conducting. This triggers the IC1 so it produces the high output. The relay1 is energized by the IC1 from pin no. 3 through the diode. The open contact terminal of relay is connected to the V_{CC} and closed contact terminal to the GND. The relay COM terminal is connected to the bridge rectifier which feeds the timer IC3. This timer produces the square pulses, which saturates the transistor (NPN, SL 100). The output of the transistor is connected to the L293 IC which controls the rotation of the motor connected to the solar panels. When the solar rays are from west to east the LDR2 gets the light and starts conducting. This triggers the IC2 so it produces the high output. The relay1 is energized by the IC2 from pin no. 3 through the diode. The IC3 timer produces the square pulses, which saturates the transistor (NPN SL 100). The output of the transistor is connected to the L293 IC which controls the rotation of the motor connected to the solar panels. Hence the direction of the solar panels is adjusted according to the sunrays.

3.2 Auto panel motor control

When tilting of the solar panel is required the motor is automatically turned on. The circuit diagram for auto turn motor control is shown in the figure.8. The circuit is designed using IC 555 operated in the bi stable mode, and double contact relay to trigger the motor fitted below the solar panel. The two switches SET and RESET determine the direction of the motor when activated. The two COM terminals of the relay are connected to the IN1 and IN2 pins of the IC L293 (motor driver).

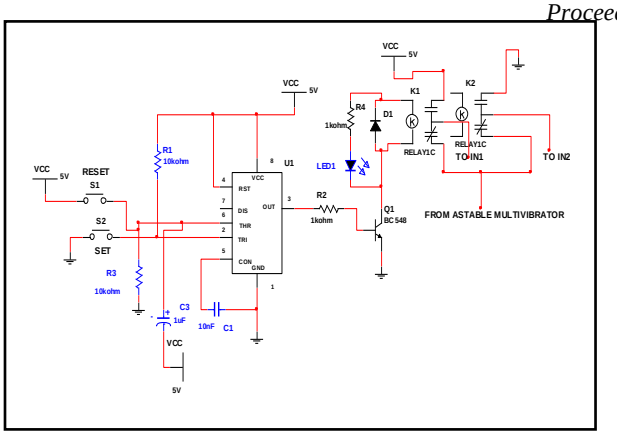

Figure.8 Circuit diagram for auto turn motor control for solar panel

The normally open terminals are connected to astable multivibrator where as the normally closed terminals are connected to the V_{CC} and GND.

The two switches are fitted to the extreme ends of the solar panel. Initially, since the RESET switch is activated the IC is not triggered therefore the transistor is in cut off condition, the relay is not energized and it gets the signal from the stable multivibrator and accordingly the panel motor is driven. As the solar panel rotates according to the intensity of the sun rays it reaches the other end i.e. the set switch now triggers the 555 timer. The transistor at its output is saturated and in turn energizes the relay. Now the IN1 and IN2 terminals get the signal from this circuit and rotate the motor in the reverse direction, back to its initial position.

3.3 Automatic gate controller

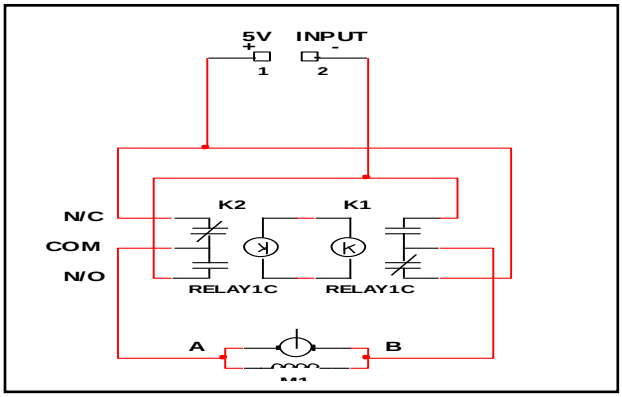

Figure. 9 Circuit diagram for automatic gate control

The circuit diagram for bi-directional door motor controller is shown in the figure. 9. The circuit uses two changes over relay (Double contact relay) and bi-directional motor. The motor terminals A and B are connected to the COM terminals of the double contact relay. The motor gets external voltage from the COM and "NC" (normally closed) contacts. At normal condition the relay coil is not energized, so the motor terminal 'A' gets positive voltage and 'B' gets negative voltage. Because of this motor rotates in the forward direction and door remains close. When relay gets input from another circuit, the coil energizes and at this instant COM and "NO" (normally open) terminals are closed circuit and relation of terminals COM and "NC" is open. Now the motor terminal A gets negative voltage and 'B' gets positive voltage from COM and "NO" terminals of the relay. This makes the motor to rotate in the reverse direction and door is opened.

3.4 Light indication at reception

In order to indicate the arrival of the ambulance into the hospital an light indication arrangement is done at reception so that the doctors or staff of hospital can take immediate action. The circuit diagram for this light indication is shown in the figure.10. The LED's are connected to the decoder HT 12D which is in turn is connected to the gate control circuit whenever diode is forward biased light glows which indicates the vehicle arrival. Whenever the gate is closed the diode is reverse biased there will be no indication of light resistor 1KΩ is used to bias the transistor.

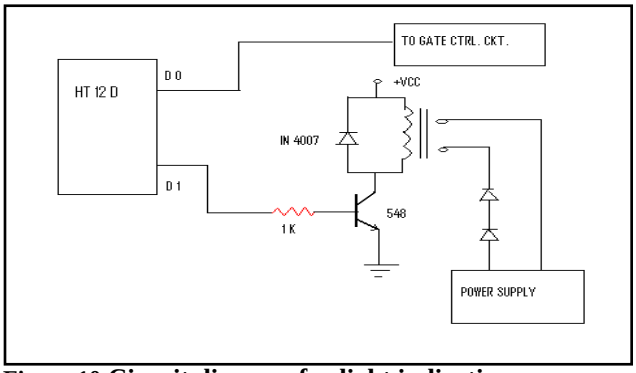

Figure.10 Circuit diagram for light indication

3.5 Alarm generation system

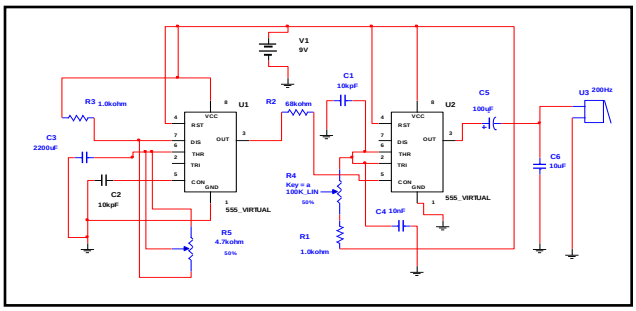

Figure.11 Circuit diagram for alarm generation

For the purpose of alerting peoples and security persons, it is important that to alert them with audio and visual indication. The circuit diagram for siren generation system is shown in the figure 11. The circuit described here is an audio indication system in the form of siren sound. The circuit is designed with 555 dual timers. Both the timers are designed as an astable multivibrator. The timer IC used here is a dual timer which is in a single 14-pin DIP.

The output of first timer is connected to the control voltage input of second timer, so that it can adjust the reference voltage of threshold and trigger pins of second timer. The first astable multivibrator output frequency can be changed with preset (variable resistor) and capacitor 1000µf / 25 V. The square wave output of first timer is connected to the control voltage pin of second timer through the 60KΩresistor. The second timer which is also designed as astable multivibrator and the frequency of that can be varied in the same technique of the first timer i.e. by varying 100KΩ preset and 0.01µf capacitor.

The first timer which rapidly changes its output also changes the reference (control voltage pin) voltage of second timer.

Therefore the second output goes on varying its output frequency as per their reference voltage input.

The output wave shape which is available after Pin No.3 has been passed to speaker through a capacitor 100µf which filters DC and allows signal and because of this is in the range of audio frequency speaker produces the tone which is an actual effect of siren.

3.6 Patient temperature sensing

The thermistor is used as a "thermal sensitive resistor". The thermistor is used to sense the body temperature of the patient & the circuit diagram for patient body temperature is shown in the figure. 12. Here the op amp is used as a voltage comparator. The thermistor 'T' and variable resistor VR1 are connected to the non-inverting terminal Pin No.3 of the op amp to provide the potential difference.

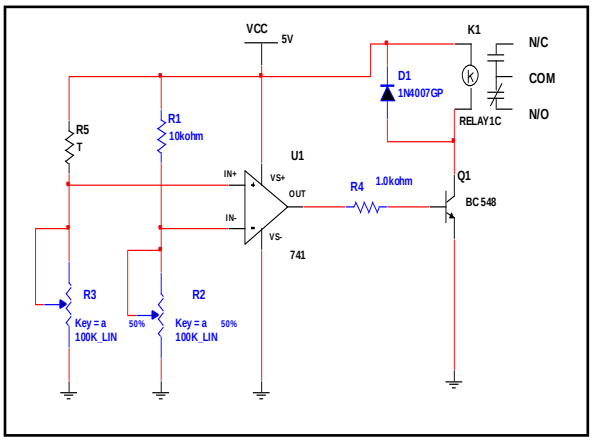

Figure.12 Circuit diagram for patient temperature sensing

The inverting terminal Pin No.2 of the op amp gets the potential difference from resistor R1 and variable resistor VR2, to adjust the reference voltage. Under normal temperature, thermistor resistance is very high. So the voltage at Pin No.3 is less than the Reference Voltage. As soon as temperature increases, thermistor resistance decreases which increases the voltage at Pin No.3 i.e. non-inverting terminal of the op amp. Now because of this condition the potential difference between two inputs at comparator also changes and the output of the comparator goes from its low to high state to activate (Saturate) the transistor. The collector of the transistor further drives relay. As long as the temperature is maintained high the op amp output remains in the same state. When temperature falls down on thermistor, its resistance goes to increase. This decrease the voltage at Pin No.3. Because of this condition the op amp i.e. comparator output changes from its high to low state. At this instant the transistors goes to cutoff and deactivate the relay.

3.7 Walking plate stimulator

Utilities for challenged patients are designed. It has plates and whenever patient applies pressure or puts his foot on these plates it generates various kinds of color which is done using push buttons which is placed at the bottom of the plate and colors are indicated using LED's. Along with the colors, also have designed such that even musical tones are generated which acts as motivating factor for the patients to walk

Figure.13 Circuit diagram for walking plate stimulator

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4. ADVANTAGES

1. Uses renewable energy
2. Eco-friendly
3. Monitors the patient's respiration rate and displays in the hospital
4. Stimulates nerve cells
5. Stimulate the disabled persons to walk without support
6. Helps the blind person using intelligent blind stick to avoid accidents and alters the person

5. CONCLUSION

An ambulance has been designed which is utilises solar energy in order to save the faster depletion of non-renewable resources. Auto tilting solar panels helps in improving the efficiency of the vehicle. In this ambulance patient's body critical signals monitoring is also done. Further, automatic gate controlling is also done whenever the vehicle arrives at the hospital the gate is opened automatically. As the vehicle arrives there is also light indication at the reception to indicate about the vehicle arrival in order to make arrangements in the hospital.

Utilities are also designed in order to help the patient to recover from their walking disabilities. Walking plate stimulator generates various musical tones and colours when the patient applies the foot pressure on the plate. Further, there is also an intelligent information blind stick to help blind people to prevent from accidents**.**

6. PHOTOGRAPHY OF PROTOTYPE MODEL

Figure 14 Solar ambulance with tracking system

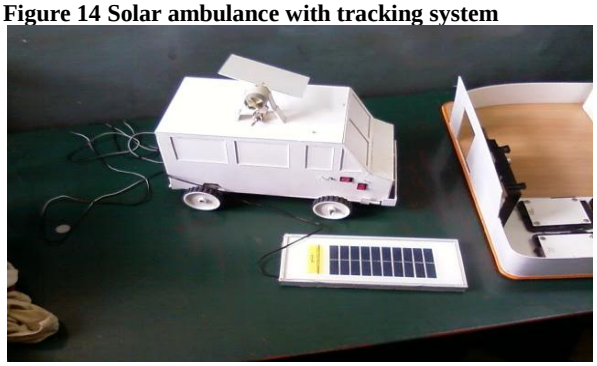

Figure 15 Ambulance with hospital unit

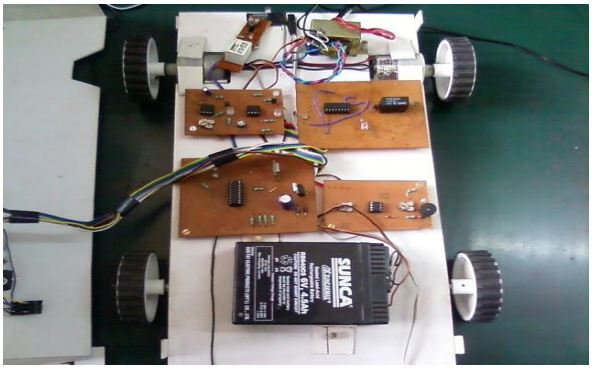

Figure.16 Arrangement at the ambulance

Figure. 17 Walking plate stimulator

7. ACKNOWLEDGEMENT

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