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First Prize

DESIGN FOR EFFECTIVE DEGRADATION OF INDUSTRIALLY IMPORTANT TEXTILE DYES BY MICROORGANISMS ISOLATED FROM ACTIVATED SLUDGE

COLLEGE	:	B. V. BHOOMARADDY COLLEGE OF ENGINEERING AND TECHNOLOGY, HUBLI, KARNATAKA
FACULTY SUPERVISOR	:	PROF. ZABIN K. BAGEWADI
STUDENTS	:	ABHIJIT LIMAYE AISHWARYA PATIL AMIT VERNEKAR VANDANA JAIN

Second Prize

STUDIES ON BIOFUEL FROM ALGAE-CULTIVATION OF ALGAE USING SEWAGE WATER AS SOURCE OF NUTRIENT AND WATER AND DEVELOPMENT OF INNOVATIVE PROCESS ON EXTRACTION OF CRUDE FROM ALGAE

COLLEGE	:	R. V. COLLEGE OF ENGINEERING, BANGALORE
FACULTY SUPERVISOR	:	PROF. D. RANGANATH
STUDENTS	:	JANI JAGAT M JOHAN SAUL ALVA DEVESH KUMAR BIPIN TIWARI

Third Prize

LOW COST INTELLIGENT VEHICLE FOR DIFFERENTLY ABLED WITH GESTURE AND VOICE CONTROLS

COLLEGE	:	MEPCO SCHLENK ENGINEERING COLLEGE, SIVAKASI, TAMIL NADU
FACULTY SUPERVISOR	:	MR. C. KALYANA SUNDARAM
STUDENTS	:	M. BHARATH KANNAN S. MUTHU NATARAJAN A. VENKATA KRISHNAN

21. DESIGN FOR EFFECTIVE DEGRADATION OF INDUSTRIALLY IMPORTANT TEXTILE DYES BY MICROORGANISMS ISOLATED FROM ACTIVATED SLUDGE

Aishwarya Patil, Abhijit Limaye, Amit Vernekar, Vandana Jain and Prof. Zabin K. Bagewadi (FS)

B. V. Bhoomaraddi College of Engineering and Technology, Hubli

Introduction

Reactive dyes are typically azo-based chromophores combined with various types of reactive groups, which show different reactivity. They are extensively used in many textile industries .Water is the only efficient carrier. The management of wastewater from reactive dye operations is currently a single most pressing environmental problem in the textile dyeing industry. Physical and chemical methods cannot be used always easily for wastewater treatment due to high cost, low efficiency and in-applicability to a wide variety of dyes. Biological degradation method is considered as effective, specific, less energy intensive and environmentally benign. This work was aimed at evaluating actinomycetes for their ability to decolorize several synthetic dyes and textile effluents in solid and liquid cultures. An attempt has also been made to analyze the concomitant association of ligninolytic enzymes production from fungi (lignin peroxidase, manganese peroxidase and laccase) and decolorization of dyes and effluents by these fungi. Enzymes are

frequently used, as biocatalyst for process improvement, to enable utilization of new types of raw materials, production of metabolites through biotransformation, texture improvement in textiles. Immobilization imparts more operational flexibility due to the fact that it prevents biomass washout in continuous flow reactors, allows the use of higher cell densities than those obtainable with free cell systems, facilitates the separation of biomass from the treated effluent and offers the potential for improving wastewater treatment and solves the problems associated with solid-liquid separation in settling tanks Catalytic stability can be greater for immobilized cells than for free cells and some immobilized microorganisms tolerate higher concentrations of toxic compounds than do their non-immobilized counter parts. The supports used for cell adsorption are wide and varied, which includes ceramics, porous glass, polyurethane foam, Nylon web stainless steel biomass support particles.

Implementation

Reactive Yellow dye was collected from dye manufacturing unit Atul, Gujarat (India). The sludge sample was collected from textile industries near Gadag.

The Mineral Salt Media (MSM) was used for isolation of dye degrading organism. The media was filtered using Whattman filter paper no.40 and autoclaved at 15lbs pressure for 20min. Isolation was done by spread plate method after suitably diluting the sample in saline solution.

The obtained isolates were screened for best dye degraders by point inoculation of the Isolate on an agar plate containing 5 ppm of dye concentration.

Degradation studies

The medium used for degradation is Vogel’s Mineral Media [resmi c senan]. After sterilization 20% of inoculum was added

and degradation efficiency of isolate was found out at 500 ppm and 1000 ppm concentration of dye used as the sole source of carbon. The samples were evaluated using UV-Visible spectrophotometer (Labomed) method. To determine percentage reduction, the supernatant was read at the λ_{max} = 410 nmof the dye.

$$\text{Decolorization percentage} = \frac{(I - F)}{I} \times 100$$

Where, I is the initial absorbance and F is the absorbance of decolorized medium.

Enzyme assay : The cell pellet was suspended in 50 mM phosphate buffer (pH 7.4) for sonication (Ultrasonic homogenizer, sartorius) with sonicator out put 80 amplitude maintaining temperature at 4° C and giving 5 strokes each of 10 s with 10 min interval. This extract was centrifuged and the supernatant was used as a source of crude intracellular enzyme. Lignin peroxidase (LiP), laccase and tyrosinase activities were assayed in cell homogenate. LiP activity was determined in reaction mixture of 5ml containing 100mM n-propanol, 250M tartaric acid, 10mM H_2O_2 by monitoring the formation of propanaldehyde at 300nm. Laccase was determined in a reaction mixture of 2ml containing 5Mm O-tolidine,20Mm acetate buffer, 0.2ml of enzyme solution at 366nm.Tyrosinase activity was determined in reaction mixture of 2ml containing 0.01% catechol in 0.1 M phosphate buffer (pH 7.4) at 495 nm. One unit of the enzyme activity was defined as a change in absorbance U / mg protein/ min of the enzyme.

Effect of pH on degradation of dye : The degradation is to be carried out at a wide range of pH, in order to optimize the degradation process. The Vogel's mineral media (VMM) was used for degradation process and the pH of media was set to 3, 5, 7, 9 and 11 with 20% of inoculums and 0.05% of dye. To

determine percentage reduction, the supernatant was read at the λ_{max} = 410 nm of the dye.The decolorization percentage was calculated as mentioned above.

Effect of temperature on degradation of dye: The degradation is to be carried out at wide range of temperature, in order to optimize the degradation process. The Vogel's mineral media (VMM) was used for degradation process and media were supplemented with 20% of inoculums and 0.05% of dye, the temperatures of media were set to 20, 30 and 45°C. To determine percentage reduction, the supernatant was read at the λ_{max} = 410 nm of the dye. The decolorization percentage was calculated as mentioned above.

Fermentation Studies : The media used for fermentation was potato dextrose broth containing 2% glucose pH 5 temperature maintained 30°C and the stirrer speed was 150 and the air flow rate was 4lpm. The fermentor used was Sartorious B-lite of 3l capacity. Samples were collected every 3 hours and analysed by UV-spectrophotometer.

Immobilization Studies : Whole Cell Immobilization was performed and at different concentration the degradation efficiency was checked. 3% solution of sodium alginate was prepared. 0.2 M calcium chloride solution was prepared and autoclaved. Immobilized cells were prepared by dropping the mixture of sodium alginate and cells into $CaCl_2$ solution. Immobilized cells was suspended in Vogel's Mineral Media containing 500 ppm and 1000 ppm of dye and for analysis of degradation samples were collected at the interval of 1 hour and analysed by UV-Spectrophotometer.

HPLC Analysis of Degraded Products: Culture broth was centrifuged at 12,000g for 30 min HPLC analysis (Agilent Technologies) was carried out on C18 column with methanol: water (80:20) as mobile phase at flow rate of 1.0 ml/min for 5 min at 410 nm.

Results

One bacterial culture (A) was found to have higher potential for degradation of dye and hence was used for further studies. The isolate after Gram's staining was found to be Gram negative rod. After prolonged incubation of plates one fungi (B) was found to be capable of degrading the dye. This fungi was screened for its degradation capacity by using an agar plate containing 5ppm dye and a zone of clearance was observed after incubation for 4 days. These isolates were adapted to different concentrations of dye. The bacterial isolate was adapted till 50 ppm dye concentration whereas; the fungal culture could successfully degrade the dye till 2000 ppm of dye concentration. For, degradation studies 50ppm and 100 ppm of dye concentration were found to be ideal and hence all assays were performed at these two concentrations for fungi and for bacteria only 20 ppm dye concentration was used. The degradation efficiency of isolate A was found to be 73% in 48 hours and that of B was found to be 96% in 24 hours for 50 ppm dye and 95% in 25 hours for 100 ppm Crude extracts of three intracellular enzymes were obtained by sonication and checked for their activity. The maximum activity was found at 9 hours for laccase and tyrosinase and at 5 hours for lignin peroxidase. Hence, we can say that the degradation is due to the action of enzymes as these enzymes are involved in the degradation of dye.

The effect of pH and temperature on degradation of dye was performed for 50ppm dye concentration and it was observed that pH 5 and 30°C temperature was optimum for Degradation by isolate B in a span of 11 hours.

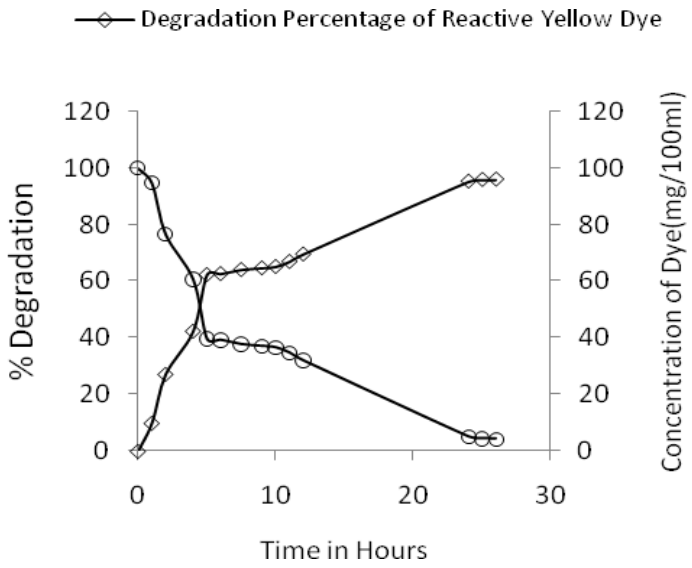

Figure 1: Degradation studies of Reactive yellow dye at 0.05% (50mg/100ml) with Enrichment at shaking condition

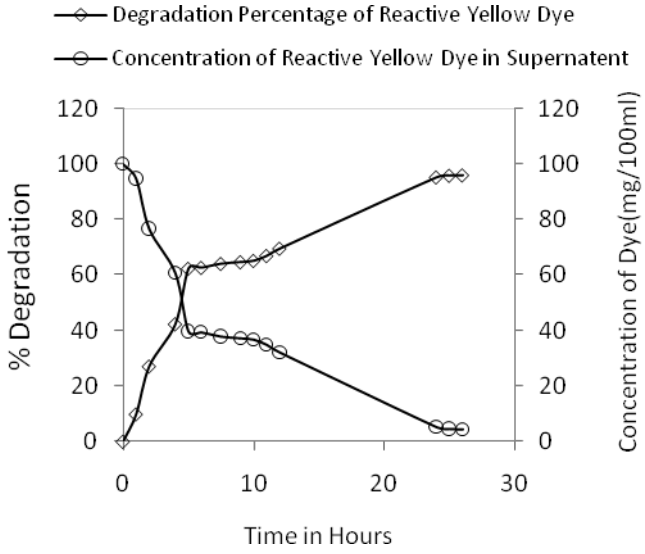

Figure 2: Degradation studies of Reactive yellow dye at 0.1% (100mg/100ml) with Enrichment at shaking condition

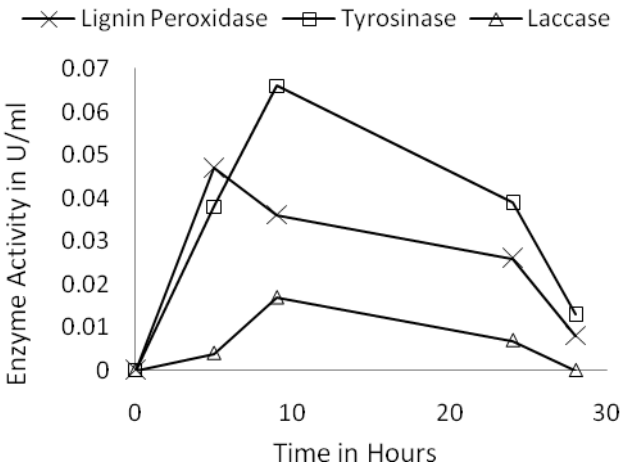

Figure 3: Time course of LiP, Tyrosinase and Laccase activity in Units/ml in during Reactive Yellow decolorization at initial dye concentration of 0.1 %*(100mg/100ml)

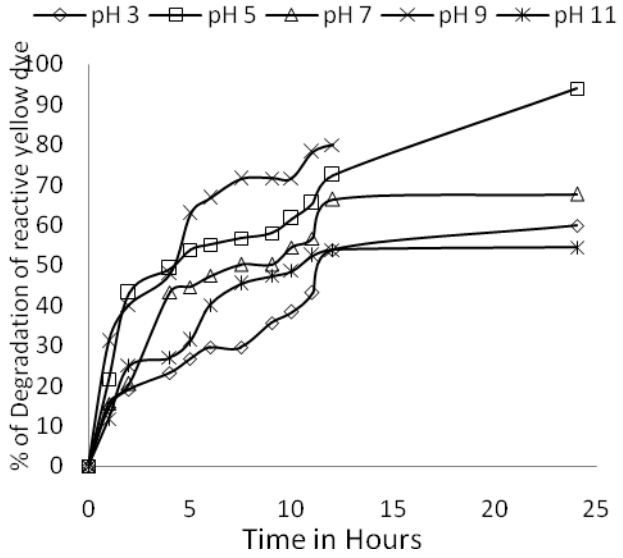

Figure 4: Degradation studies at different pH of Reactive yellow dye (50mg/100ml) at shaking condition

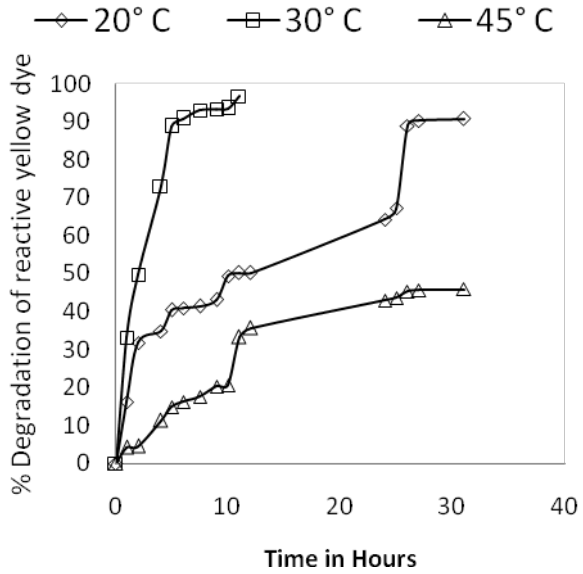

Figure 5: Degradation studies at different temperature of reactive yellow dye(50mg/100m)l at shaking condition

The degradation efficiency of the isolates was checked in a 3l fermentor for both isolate A and B. The isolate A could degrade the dye to 73% at 20ppm in 53 hours while isolate B could degrade it to 57% in 11 hours. Hence the degradation capacity of fungi was higher than bacteria. The immobilization studies for isolate B was performed and the dye was degraded 88% in 11 hours at 50ppm and 95% in 24 hours for 1000ppm. Hence, we can say that whole cell immobilization is an efficient method for degradation of dye. Further, trial runs were performed on a reactor designed to degrade the dye containing whole cell immobilized cells as packing material. At 10ppm dye concentration isolate B could degrade the dye 62.5% in 5 hours. The reactor was of 5l capacity and had a stirrer of 150rpm and aeration was provided. The HPLC analysis showed that the dye was degraded and some intermediated could be detected in the chromatogram. One of the peaks was identified to be of the residual dye with a Rt value of 1.001 min and another peak is

suspected to be of an intermediate dimethyl amino phenol which has a Rt value of 2.9 mins.

Design of Bioreactor

Bioreactor is designed in order to carryout degradation at a lower cost. There are two stages involved in this process. In the first stage, the pH and temperature of industrial waste is changed according to our optimum conditions used for degradation. Along with that a stirrer is provided for uniform mixing and this is passed to second stage were the organism will be in contact with bed, it act as support and utilizes dye as a source of carbon to grow and thus degrades dye.

Reactors used for degradation

Conclusion

From the present studies we can conclude that both the isolated microbes are capable of degrading the dye and isolate B has more potential over isolate A. Also, we can say that the immobilisation of these organisms is an effective method for improving the degradation ability of these isolates. The reactor designed can be utilised to degrade the dye at lower concentrations. Hence, biodegradtion can be used to degrade the dye and to treat waste water effectively.

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19. STUDIES ON BIOFUEL FROM ALGAE-CULTIVATION OF ALGAE USING SEWAGE WATER AS SOURCE OF NUTRIENT AND WATER AND DEVELOPMENT OF INNOVATIVE PROCESS ON EXTRACTION OF CRUDE FROM ALGAE

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RV College of Engineering, Bangalore

Introduction

Biofuel from microalgae is the answer for clean and abundant fuel. Algae based fuels have the potential to replace fossil fuels, hence it is of foremost importance that a breakthrough in this field is made; by genetically increasing rates of growth, optimizing biofuel conversion techniques, integrating with another process such as wastewater treatment to offset costs.

Literature

Spirogyra is unbranched with cellular cells connected end to end in long green filaments. In general, Spirogyra has the following composition breakup:

Species	Protein	Carbohydrate	Lipid
Spirogyra	6-20	33-64	11-21

Motorola Scholar Programme : 2011-12

Algae are an easily sustainable, low GHG (green house gases) emitting feedstock that grows more rapidly and yields more biofuel per hectare than any other existing oil plants. In addition, algae biofuel contains no sulfur or other toxic substances, does not require arable land, has excellent fuel properties and is highly bio-degradable. Algae grow rapidly and like any other plant require water, light, carbon dioxide and nutrients. Thus microalgae have the capability to contribute significantly to the overall resource potential of biofuels to displace petroleum fuels.

Methodology

Samples were collected from Sankey Tank, Malleshwaram, Bangalore and were identified as belonging to Genus *Spirogyra* under a microscope.

Cultivation of Algae

Algae were grown in simple rectangular tubs that had the following dimension: length - 43 cms, width - 32 cms, height - 13.5 cms. To determine best medium for algal growth several experiments were performed using various mediums. Mediums used were autoclaved soil- tap water, steamed soil- tap water, untreated soil- tap water and only tap water. Waste water was diluted an used as a medium.

The algae cultivation procedure was the same for all sets of experiments and is as follows.

1. Tubs to be used were cleaned thoroughly.
2. Fresh algae obtained was neutralized with 1% NaOH and then washed with distilled water to remove all impurities.
3. Tubs were filled with the appropriate culture medium (nutrient source) as per the experiment demanded.
4. Algae culture was then added.

5. Nets were placed over the tubs to prevent insects or birds from feeding on the algae.
6. Algae culture in the tubs was then allowed to grow naturally at prevalent weather conditions and under direct sunlight.
7. Growth of algae was monitored every 2 days and data was tabulated.

Fig 1. Preparation of soil- tap water medium

Fig 2. Growth observed on 2nd day after initial culture was added

Fig 3. Preparation of wastewater- soil medium

Fig 4. Growth observed on the 2nd day after initial culture was added

Extraction of Oil

Heat Reflux Method: The extraction of oil experiment from algae was performed in the heat reflux condenser setup. Algae of known weight were taken in round bottom flask and measured amount of solvent was taken in it. The reaction mixture was kept on heating for eight hours. The solution was decanted and filtered using Whatman filter paper. The filtrate contained algal oil and solvent. The solvent was removed using rotary evaporator in water bath. The remaining solution was algal oil. The oil extracted algae was again heated by adding recovered and fresh

solvent for same time and the procedure was repeated for four times. The yield was measured. The purity of sample was measured using gas chromatography test.

Fig 5. Heat reflux extraction. Soxhlet extraction apparatus

Soxhlet Method : Finally obtained algal oil was measured and yield was noted down. The purity of oil was measured using gas chromatography test.

Rotary Evaporation

Round bottom flask with oil-solvent mixture was rotary evaporated under vacuum at 60^{o}C to obtain pure oil extract. Solvent was recovered after every experiment.

Results

The algae cultivated with waste water as nutrient source. The optimal dilution ratio (ratio of tap water to waste water) was found to be 70: 30. The best medium was found to be autoclaved soil and when combined with diluted waste water growth rates

were found to have increased positively. The highest growth rate obtained was 25.62 $g/m^2/d$ of algae measured on a dry basis.

Simultaneously extraction processes were carried out by both Heat Reflux and Soxhlet methods using solvent systems such as hexane, chloroform-methanol and hexane-diethylether. It was found that heat reflux method coupled with chloroform-methanol solvent system gave the highest oil extraction with respect to weight of dry algae used. The yield obtained was 13.1 %. The oil obtained was analysed by Gas chromatography to determine the fatty acid composition which has given positive report for the transesterification and for good biodiesel quality.

Problems Faced

During cultivation water evaporated and had to be added to system every other day.

Amounts of oil extracted were less hence unable to perform transesterification. This is due to species which does not have high lipid quantity when compared to some other species.

Algae matter like cell material; chlorophyll etc. got extracted by solvent. After evaporation of solvent, solvent became free of it.

After extraction of oil from algae using solvent, solvent had to be removed. Oil stuck to the sides of the R.B. Flask and had to be dissolved again into solvent.

Applications

- Can be integrated into a waste water treatment process.
- Can produce biofuels to supplement fuel supplies.

Disadvantages

- Technologies are not highly developed hence cost of production is high.
- Large scale implementation differs totally from lab-scale dynamics.

Future Work

Recommended future work would be to integrate algae cultivation systems into waste water treatment plants which would cut costs for removing toxins that as demonstrated are removed by algae while at the same time have a possibility to produce biofuels. Also the possibility of eliminating the oil extraction step by directly converting algal biomass into biofuel by a simple and scalable process should be looked into.

Conclusion

Algae have the potential to become exclusive fuel suppliers in the near future. This is because algae are fast growing, and disputably renewable.

The project work illustrates the capability of algae in terms of cultivation and extracting oil from algae. It is of significant value that cultivation of algae and extraction methods are feasible and can easily be done if the infrastructure is present.

Reference

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16. LOW COST INTELLIGENT VEHICLE FOR DIFFERENTLY ABLED WITH GESTURE AND VOICE CONTROLS

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Introduction

The technologies which had evolved have always been a thing of little reach in the general public. The existing approach uses a joystick for direction control with no additional features like automated path traversal, obstacle detection and evading, voice based commands etc. Even the joystick controlled wheel chair costs a hefty some to the user. Moreover it imposes a criterion on the user that he/she should have complete limbs to control the joystick. This further narrows down the scope of usage of the vehicle. The cost of such machines makes such vehicles unaffordable to the public.

The primary aim is to make an affordable versatile locomotory system for the differently abled common man. We have focussed on obtaining real time signals from the user and from the environment and processing it accordingly for the effective control of locomotion.

Problem Definition

To design and develop a low cost vehicle for differently abled which would bestow them with locomotion that they would crave to get, with features like,

- Voice Based Control

Motorola Scholar Programme : 2011-12

- Gesture based Control
- Automated Obstacle detection and evading
- Predetermined Path following.

Design of Intelligent Locomotive System

The system consists of a Gesture sensor and a module that is capable of sensing the gestures so that the gestures read can be processed by the micro-controller and then appropriate decisions can be made. The control signals can thus be issued by the micro-controller which can make the vehicle to move. Gesture sensor is devised by an accelerometer that is capable of sensing the three dimensional variations.

The system also consists of an obstacle detector. The obstacle detector senses the presence of an obstacle in the path. It then issues a signal to the micro-controller the micro-controller recognizes the signal issued by the obstacle detector and then takes appropriate actions. This obstacle sensor is made use of in the intelligent obstacle mode, in this mode when an obstacle is encountered the micro-controller can be programmed so as to evade the obstacle.

The system also has automated path traversal in which the vehicle moves on a pre-determined path. The predetermined path can be even a line that is drawn on the floor. Switching between these modes is also made possible. The Block diagram model of the intelligent system is shown in Figure 1.

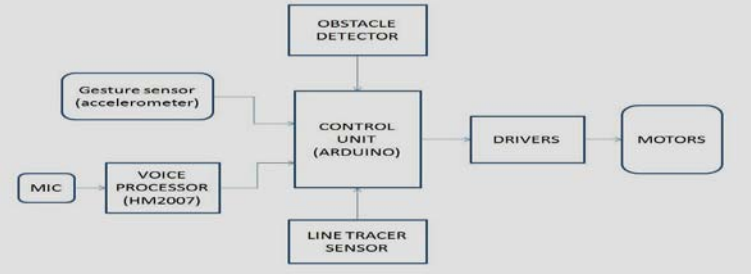

Figure 1: Block Diagram of Intelligent Locomotive System

Construction

The gesture control is brought about by means of the gesture control module which is attachable to and detachable from the hand. The module is placed on the arms of the chair and is accessible easily by the person. The mic for the voice control is a headset microphone, placed nearer to mouth for better noise resistance. The obstacle detection sensor is placed in the front side of the locomotory vehicle.

The voice and gesture controls are over-ride able on each other with the exception that no obstacle is detected. Intelligent obstacle mode is non-maskable. The modes can be switched to, by means of a preset gesture sequence or a voice command or the externally provided switch. The commands can be words or distinct sounds which are trained before the first use.

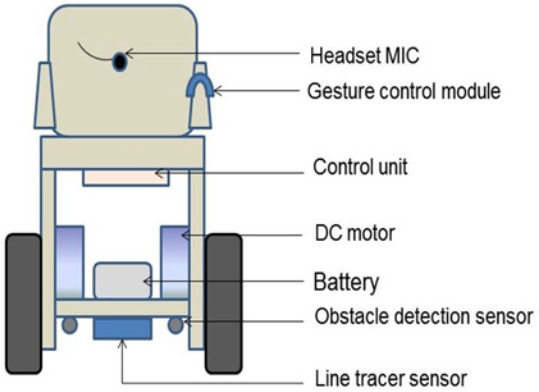

Figure 2: Proposed Model of our product

Programming is done for the obstacle mode and the line following mode. In case of the obstacle mode the program specifies the amount of turn required and for line following mode it defines the following operation. Programming is done using embeddsed C.The drivers are interfaced with the embedded microcontroller to drive the motors. A vibration actuator is provided to show the user incase the vehicle has halted due to

obstacle. A Model diagram of the intelligent vehicle is shown in Figure2.

Snapshots of the Miniature Prototype Model

The snap shots of the front and side final fabricated Intelligent locomotory system is shown in Figure 3 and the Control Circuit implementation is shown in Figure 4.

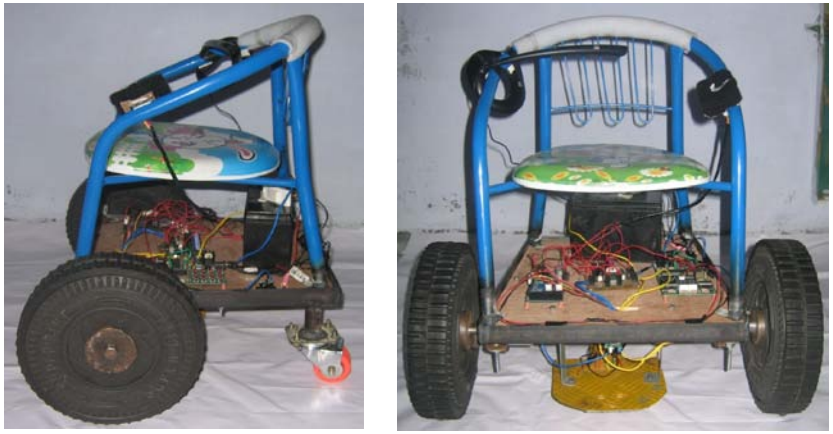

Figure 3: Side and Front view of the Prototype Model

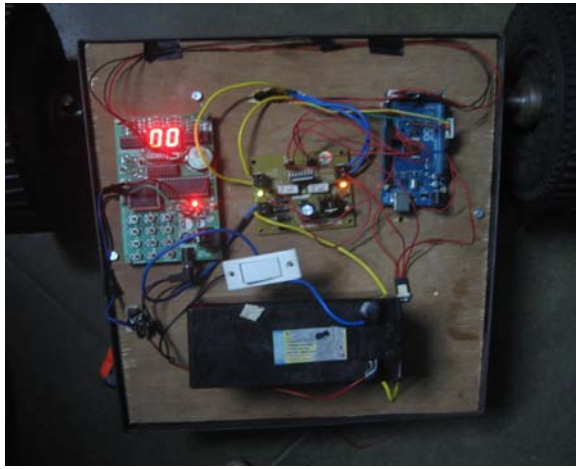

Figure 4: Control Circuit

Operation

The wheel Chair can successfully operate in many modes. The operation of the intelligent wheel chair in different modes are as follows.

Gesture mode: Gesture mode of the Intelligent Wheel chair is activated by pushing the switch1 to ON position.The gesture control module uses of a gesture sensor. The Gesture sensor employed here is a 3 axis Accelerometer [ADXL335]. The gestures can be like tilting ones hand forward for the forward motion of the locomotary system and tilting it still forward to increase the speed of forward motion and also like tilting the hand backward during forward motion of the system to apply breaks or to initiate reverse motion and moving ones hand right or left to initiate a turn.The setup consists of an accelerometer interfaced with an embedded micro-controller which constantly checks for three axis values and decisions are taken accordingly. The directional motion is chosen by the movement of the accelerometer.

Voice Controlled mode: Voice Controlled mode of Wheel Chair is activated by pushing the switch1 to OFF position. The voice control module consists of a voice recognition module [HM2007 chip] which can sense out commands by the user. These words are thereby processed by the embedded controller and thereby used for controlling the locomotary system. Simple commands such as “forward”, “left”, ”right”, ”back” will enable the user to control the vehicle. Command word of convenience can be fixed and trained before the first use of the vehicle. The uttered command is processed in the HM2007 processor and it outputs binary codes which in turn are fed to the embedded micro-controller to define the corresponding operation.

Automatic Path Traversal mode : The automatic path traversal mode is activated either by giving a voice command “follow” in voice controlled mode or simple turn the switch2 ON. The system enters the automatic mode and starts traversing the

underlying pre-laid path. The user has to position over the path which he/she wants to traverse and activate this mode. The automatic path traversal mode consists of six pairs of optical sources and sensors constructed in an array form. The sensor array outputs vary with the pattern of the underlying path and these values are processed in the embedded micro-controller.

Intelligent Obstacle detection: During the locomotion the vehicle is prone to collide with obstacles. We have considered the obstacles which are of lower height because the others can be visually seen and manually can be evaded. The obstacle sensor detects the obstacle within a range of 30cm (for the miniature model).The micro-controller processes the sensor readings and the motion stops if an obstacle is detected and prompts to the user by a mild vibration. The sensor used for the miniature model is IR transmitter-receiver pair. Higher obstacles can also be evaded if we employ sensors for that particular height

Problems Encountered

- Voice Training of the Voice Board, The circuit was then altered to suit our cause and the problem was rectified.
- Driver Current Rating, We were using a lower current rating driver [max 3 A] as the load needed the motor to run on a higher current rating for the system to move fast. But the lower current rating couldn't provide that high current rating. We then fixed the problem by upgrading the driver to 20A.

Cost Ananlysis and Future Prespectives

Component	**Cost**
Arduino Mega	3000
Voice Board [HM 2007] with Microphone	4700
Motors[Two High Torque DC Motors]	1800
Chassis [Frame/Wheels/Free wheels/Chair]	500
Accelerometer	900
Driver [20A]	900
Battery	700
Wires/Leds/IR sensors	200
Total	12700

The cost can be brought even lesser many folds with large scale production. The full functional working model can be fabricated with a cost of Rs.15000 which is quite cheaper than the so-called electric wheel chairs available in the market [Reference 1].

Conclusion

Thus we have developed a low cost intelligent locomotory system for differently abled with gesture and voice controls. The system also has safety collision evading method so as to avoid unnecessary accidents. The intelligent locomotory system will be of great use to differently abled people giving them the virtue of locomotion. This will also boost their morale and make them feel that they are in no way inferior to us.

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