

The Rufford Foundation Final Report

Congratulations on the completion of your project that was supported by The Rufford Foundation.

We ask all grant recipients to complete a Final Report Form that helps us to gauge the success of our grant giving. The Final Report must be sent in **word format** and not PDF format or any other format. We understand that projects often do not follow the predicted course but knowledge of your experiences is valuable to us and others who may be undertaking similar work. Please be as honest as you can in answering the questions – remember that negative experiences are just as valuable as positive ones if they help others to learn from them.

Please complete the form in English and be as clear and concise as you can. Please note that the information may be edited for clarity. We will ask for further information if required. If you have any other materials produced by the project, particularly a few relevant photographs, please send these to us separately.

Please submit your final report to jane@rufford.org.

Thank you for your help.

Josh Cole, Grants Director

Grant Recipient Details	
Your name	Dr. Sanjoy Deb
Project title	Design and Implementation of a Multiple Sensor Automated Warning System for Roadkill Prevention
RSG reference	18144-1
Reporting period	October 2015 to April 2017
Amount of grant	3200£
Your email address	deb_sanjoy@yahoo.com sanjoydeb@bitsathy.ac.in
Date of this report	20 th May 2017

1. Please indicate the level of achievement of the project's original objectives and include any relevant comments on factors affecting this.

Objective	Not achieved	Partially achieved	Fully achieved	Comments
Survey about the cause and pattern of Road-kill incidents on NH 209 passing through Sathyamangalam Tiger Reserve and to identify few potential Roadkill hot-spot.				Our team has made frequent visits to Sathyamangalam Tiger Reserve area and collected important relevant data which has provided some useful findings. We have restricted our survey and research activities on NH 209 within a range from 3 km before Bannari Temple to 2 km after it which is buffer zone that is because access to core zone is not allowed. Note 1
Technical survey on system requirements and components specifications for proposed 'Automated Roadkill Prevention System' (ARPS) hardware design				Through present research, a low-cost 'Automated Roadkill Prevention System' (ARPS) has been be indigenously designed, developed and successfully tested.
Design and development ARPS hardware prototype				The hardware design of ARPS has fallowed innovative and modified (from existing reference) approach whereas the operation algorithm and system architecture are fully innovative.
Test demonstration of ARPS in indoors and out door environment and design finalization				ARPS has been tested successfully several times at indoor and outdoor environment. Finally, ARPS prototype working and functionality has been demonstrated at Rufford India Conference, 23rd to 26th April 2017, Ranthambore National Park in Rajasthan.
Field implementation of ARPS system at few Roadkill hotspots on NH 209 at Sathyamangalam Tiger Reserve				The first prototype system is going to be implemented at Mukundra Hills (Darrah) National Park, Rajasthan.

Note 1: Survey on NH 209 at Sathyamangalam Tiger Reserve Area:

We have conducted survey about the cause and pattern of roadkill events on NH 209 at Sathyamangalam Tiger Reserve (STR). We have found few interesting possible facts behind Road-kill incidents happening at our study area.

Fact 1: As per our observation, most of the roadkill is happening at evening and morning time when many animals are crossing road to get access to vegetable fields especially at those area where on side of road is agricultural field and other side is forest. More preciously speaking, mostly at the late evening time when road traffic is comparatively heavy between (5.30 to 8.30 pm).

Fact 2: There are few stretches of road just before and after Bannari Temple which are basically death traps for wild animals. That is because those sections are long and straight so car generally picks acceleration at those locations which literally causes more frequent road kills.

2. Please explain any unforeseen difficulties that arose during the project and how these were tackled (if relevant).

- The low-cost multiple sensors based roadkill prevention system designed under this project is a true example of indigenous development where system architecture, operation algorithm and significant portion of hardware are designed for the very first time. Since, very little previous references were available on such system; it took intense effort, longer time and significant amount of money for the development of first working ARPS prototype. As an example; the LASER transmitter and receiver PCB which is an indigenous design under ARPS, took more than 20 failure attempts before first successful design.
- Conducting survey and identifying few roadkill hotspots on NH 209, have posed lots of difficulties due to permission issue from local forest department. As an example; stopping inside the forest, taking photograph, taking measurement etc. are strictly prohibited without proper permission letter from Tamil Nadu (State) Forest Department.
- The local forest department doesn't have any specific statistical data on roadkill incidents which have occurred during last 5 years on the target stretch of NH 209 passing through Sathyamangalam Tiger Reserve. If they have some kind of information also they are not ready share it. Not only that few roadkill incidents which came into our notice during survey period were not allowed to photograph.
- Official permission has been requested from Tamil Nadu, Forest department in October 2016, for project related work and system implementation on NH 209 at Sathyamangalam Tiger Reserve but present status of the application is still unknown.

3. Briefly describe the three most important outcomes of your project.

1. Roadkill is prominent; where forest road is having long straight stretches, forest is on one side and farmland is on the other side of the road, twilight and time of dusk etc.
2. An automated multiple sensor based low cost Roadkill Prevention System prototype which is the first of its own kind.
3. Technology developed under this project can be utilised for some other relevant problems also e.g.; multiple layer LASER fence (developed under present project) can be utilised to design an automated warning system against animal intrusion in crop field.

4. Briefly describe the involvement of local communities and how they have benefited from the project (if relevant).

Not relevant.

5. Are there any plans to continue this work?

The ARPS system prototype developed under present project is a basic prototype which needs modification/up gradation to transform into a more advanced version through further research and development. Following modification/up gradation has been planed through further research and development;

1. The system algorithm presently implemented is for relatively simple animal road crossing scenario. Present algorithm needs to be upgraded in to more robust form so that it can provide reliable warning in complex animal road crossing scenarios.
2. System has to be field implemented and feedback data has to be collected for a certain duration which has not been done yet. When it will be done, the feedback data will be analyzed for the further refinement of the system in terms of algorithm, architecture and hardware.
3. Many challenges related system hardware are also planned to be solved;
 - a. Presently system is partially wireless, how to convert it fully wireless without increasing cost significantly?
 - b. Presently system is designed for night operation, how to make it work at the day time also by changing/modifying the sensors?
 - c. How to incorporate remote controlled system on-off condition, dot-matrix display for warning (instead of noted board in present case) etc.
 - d. How to add acoustic sensor (to catch animal call) and how to do relevant signal processing (segregating animal call from background noise).
4. How to modify the overall design so that system cost can be reduced further is a vital issue to be addressed further.

5. Potential applications of such low cost technology to some other sommelier conservation problem need to be studied. As an example, multiple layer LASER fence (developed under present project) can be utilised to design an automated warning system against animal intrusion in crop field.

6. How do you plan to share the results of your work with others?

We are applying for patent but we don't have any interest in getting financial benefit from it. We are ready to offer our technology to any group and individuals interested for animal conservation. We are also preparing manuscript to publish our work in repudiated international journals.

7. Timescale: Over what period was The Rufford Foundation grant used? How does this compare to the anticipated or actual length of the project?

Sl. No.	Activity	Month-Year		Grant Use (% of total grant)
		Anticipated Duration	Actual Duration	
1	Survey about the cause and pattern Road-kill incidents on NH 209 passing through Sathyamangalam Tiger Reserve.	December 2015 to February 2016 (3 Months)	December 2015 to April 2016 (5 Months)	10
2	Technical survey on system requirements and components specifications for proposed 'Automated Roadkill Prevention System' (ARPS) hardware design	January 2015 to March 2016 (2 Months)	January 2015 to June 2016 (6 Months)	5
3	Design and development ARPS hardware prototype	April 2016 to September 2016 (6 Months)	June 2016 to February 2017 (9 Months)	70
4	Laboratory and field testing of ARPS and public demonstration	September 2016 (One Month)	March to April 2017 (2 Months)	10
5	Final report filing and field implementation	October 2016 (one Month)	May to * 2017	5

* First prototype system has to be implemented yet. For official permission, application letter has been forwarded to Dept. of Forest, Govt. Of Tamil Nadu in September 2016 which is still pending. Official permission has been obtained for ARPS implementation in Mukundra Hills (Darrah) National Park, Rajasthan, India which is going to be executed in next few months.

Note: Since system has been developed on completely new and innovative concept it took little added time over anticipated duration.

8. Budget: Please provide a breakdown of budgeted versus actual expenditure and the reasons for any differences. All figures should be in £ sterling, indicating the local exchange rate used.

Item	Budgeted Amount (£)	Actual Amount (£)	Difference (£)	Comments
Salary & Wages	1000	830	+300	For survey, testing, designing and relevant tasks have been assigned to students, technical and non technical persons during entire duration of time. They have been paid on assignment basis which has been shown under this head.
Equipments	1200	1790.4	-594.4	ARPS is an innovative system which has been designed through numerous numbers of trial and error process which justify the difference. <u>Separate detail Table has been added</u>
Consumables	500	38.92	461.08	Our college has provided plenty of support in form of stationary goods and others which justify this difference. <u>Separate detail Table has been added</u>
Field Testing and Travel	500	546.44	-46.44	Our team has travelled to forest area for survey, other advanced institute and R & D organization for expert discussion numerous occasions which justify this difference. <u>Separate detail Table has been added</u>
Total in pounds	3200	3205.76	-5.76	Most of project commitments are executed which justify this difference.

Equipment's

S.No	Description of the Equipment	Total Cost (INR)
1	Jim Corbett Omnibus	230
2	Consumable Electronics	26895
3	Geosensor	2000
4	Amplifier Board	5000

5	PIC Project Board	626
6	Ultrasonic Module	150
7	Pressure sensor module, temperature	393
8	Labview Design	9831
9	P-DSLR CameraFlash Nikon D5300	42990
10	PCB Board Design	500
11	Pendrive	2095
12	Laser Sensor Cutting Work	3000
13	12v Battery and 12v/18w Solar Pannel	3149
14	Outer casting and Moulding	2000
15	Design of Laser Transmitter	4500
16	PCB Etching	500
17	LAPTOP HP 15 – AY503 Core i5 6 th gen, 8GB DDR4RAM 1TB HDD 15.6'' screen Win10 Intel Graphics Card	41000
18	PS2 to USB Converter	80
19	PCB Gerber Filming and Setup charges	1733
20	Lenovo 10400mAH Power Bank	999
21	Logitech Wireless Keyboard and Mouse	1099
22	Smacc Ultra Slim Wireless Mouse	250
23	Extension Cord	375
24	Micro USB OTG	125
25	WD My Passport 2TB	5579
26	PIR Sensor Module	3000
27	PCB Design & Development	5000
28	Motion Detector	2500
29	Xbee Module with Microcontroller Design	12500
Total		
Rs.175675 (INR) - Total in pound £1790.4		

Consumables

S.No	Description of the Equipment	Total Cost
1	Plastic Boxes	125
2	Book: Arduino	425
3	Book: Oath of Vayuputras	350
4	Courier	340
5	Courier	170
6	Cartridge	1873
7	Printout	560
8	Cover	16
9	Double side tape	200
10	Speed Post	46
11	CD with Cover	144
12	Pencil & Pen	40
Total		
Rs.4289 (INR) - Total in pound £43.71		

Travelling Allowances

S.No.	Description of Travel	Total Cost
1.	Travel to Ranthombore national park for Rufford India Conference, 23rd to 26th April 2017, Ranthambore National Park in Rajasthan (team of two persons)	20393
2.	Petrol cost for field travel	14711
3.	Visit to NCBS (Bangalore), PSG Tech (Coimbatore), IITM (Chennai) for discussion with expert on various issues.	18339
Total		
Rs. 53443 (INR) - Total in pound £546.44 pounds		

Exchange rate from INR to Pound has been considered £1= Rs.97.8 which was the rate when fund received.

9. Looking ahead, what do you feel are the important next steps?

10. Did you use The Rufford Foundation logo in any materials produced in relation to this project? Did the RSGF receive any publicity during the course of your work?

Till now no but patent application and journal publication will contain acknowledgement to Rufford foundation for their financial support.

11. Any other comments?

ARPS combines technology with ecology to provide solution for a burning biodiversity conservation issue, roadkill.



Left: Elephant in Tea-garden just beside the road, Valparai, Tamilnadu. ©Dr. Sanjoy Deb and his team. Right: A herd of elephants are crossing road at evening Sathyamangalam Tiger Reserve. ©Dr. Sanjoy Deb and his team.