Birla Institute of Technology, Mesra
Institution's Innovation Council
Institute's Innovation Contest 2020

Idea Submission Form

PART A: Idea/PoC (Product/Service/Process)

<table>
<tr><td rowspan="2">Team Details</td><td colspan="5">Team Lead:</td></tr>
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Add more fields if required

Name of the Idea/Proof of Concept (PoC)	CryCure: Saving Newborn Lives at Birth through Artificial Intelligence
Theme	**Health Care And Biomedical Devices.**
Define the problem & relevance to today's market/society/industry need *(Max 100 words)*	Every year, 3 million newborns die within the first month of life. Birth asphyxia and other breathing-related conditions are a leading cause of mortality during the neonatal phase. Current diagnostic methods are too sophisticated in terms of equipment, required expertise, and general logistics. Consequently, early detection of asphyxia in newborns is very difficult in many parts of the world, especially in resource-poor settings. We are developing a machine learning system, dubbed CryCure, which enables diagnosis of asphyxia through automated analysis of the infant cry. Deployed via smartphone and wearable technology, CryCure will drastically reduce the time, cost and skill required to make accurate and potentially life-saving diagnoses.

Propose the solution to Problem Identified *(Max 100 words)*	Samples will be first broken down into time segments. 2 1 © 2020 ZS 9 Each segment will undergo a pre-processing. The MFCCs will be then fed as input to the SVM classifier. A sample will be then classified as normal or asphyxia, if the majority of its segments were classified as such. For deployment, we will build a mobile application using Flutter. It help receive feedback from clinicians and other caregivers. Concretely, compared to the current method using a blood gas analyzer, our solution is: non-invasive, low-cost, requires little or no skill to operate, and delivers results much quicker.
Describe the product/process/ service and write how it is innovative / unique. *(Max 100 words)*	Our solution, dubbed CryCure is non-invasive (requiring only cry rather than blood), low-cost (only as expensive as the cost of a phone), requires little or no skill to operate, and delivers results much quicker (under 20 seconds). Also, CryCure is available everywhere, from rural to urban areas including semi-urban cities too. No professional training is required to use CryCure. Our solution, dubbed as CryCure, has a potential to become a revolutionary product in the healthcare industry.CryCure can help bring the mortality rate of infants down and will help infants see the light of the day.
How is your proposed product/ process/service being different/ better from a similar product/ process/ service, if any, in the market *(Max 100 words)*	In India artificial intelligence powered healthcare systems are too costly. Some of the AI startups which focus on detecting deadly diseases such as breast cancer, etc., are often very costly to use. Also, the above mentioned startups are only available in urban popular cities. These startups don't cover rural and semi-urban areas and are out of the reach of middle class people. In India, where majority of the population is middle-class and can't afford these solutions. Further to use the solutions provided by these startups the users (here nurses) must be trained properly. Our solutions counters the above mentioned problems.
If your Idea is technology based, then specify the TRL Level (Technology Readiness Level) and Expecting the features of Idea/PoC. ***Note:*** *For the Idea level, TRL 0 – 2 is expected.* *For the PoC level, TRL 3 is expected.* *(Max 100 words)* *Chose most appropriate TRL level from **Annexure 1***	TRL 0: Idea- Every year, 3 million newborns die within the first month of life. Birth asphyxia and other breathing-related conditions are a leading cause of mortality during the neonatal phase. Current diagnostic methods are too sophisticated in terms of equipment, required expertise, and general logistics. Consequently, early detection of asphyxia in newborns is very difficult in many parts of the world, especially in resource-poor settings. We are developing a machine learning system, dubbed CryCure, which enables diagnosis of asphyxia through automated analysis of the infant cry. Deployed via smartphone and wearable technology, CryCure will drastically reduce the time, cost and skill required to make accurate and potentially life-saving diagnoses. TRL 1: Proof: Goal of the government is to decrease the under-five mortality rate to 23 by 2025 in India. Although the Indian government is performing well to improve health indicators, it still needs improvement to meet global benchmarks and World Health Organization (WHO)- recommended norms, owing to large disparity in the condition of healthcare services across states, with the most populous states being the laggards. Our solution has the potential to decrease the under-five mortality rate in India. Neonatal disorder is among the top 10 causes of deaths in India. TRL 2: Technology Formulation: We are using Python as our programming language, Machine Learning, Flutter, and Firebase. The Firebase Real-time Database is a cloud-hosted NoSQL database that lets you store and sync data between your users in real-time. Our mobile app will take input such as cry sound of the infant and details, the pre-processing techniques will be applied to the input cry sound, then we will apply the above mentioned speech processing techniques, then the output will be passed to the SVM classifier. The result of the SVM classifier will be then displayed on the screen of the mobile. The data will be then stored in Firebase Database so that our model can be trained over the time.
Feasibility of Idea/PoC solution (SMART) *(Check the appropriateness of the Idea/PoC)* *(Max 50 words for each from a-e)*

(a) Specific- Specify the features of Innovative Idea/PoC.	. We are using the techniques of automatic speech recognition, machine learning, statistical analysis, and modern development tools such as Firebase, Flutter, and Python. We are using the power of artificial intelligence to save lives.
(b) Measurable- Mention the approach to convert idea/PoC to Prototype/Innovation with milestones.	Previous studies have hypothesized that breathing difficulty resulting from asphyxia alters the patterns in the cry waves of affected infants, largely attributed to the fact that speech and breathing are controlled by the same underlying physiologic process. Utilizing the infant cry to diagnose asphyxia presents a unique opportunity for the development of a more accessible diagnostic tool. In this work, we demonstrated via a retrospective study that the infant cry provides rich source of information about the physiological state of a newborn. We will further develop a prototype mobile app which could be used in resource-poor settings to reliably detect birth asphyxia. We will use techniques from automatic speech recognition. Then we will combine features extracted as coefficients of the Mel frequency spectrum with a support vector machine classifier. MFCCs are widely used in automatic speech recognition problems as they provide a representation of audio signals that closely mimic the human auditory system. SVMs are powerful classifiers that can learn complex, non-linear decision boundaries. Compared to other nonlinear classifiers like neural networks, SVMs are designed to work effectively with limited examples and high-dimensional data, as is the case in our problem. Samples will be first broken down into time segments. 2 1 © 2020 ZS 9 Each segment will undergo a pre-processing (e.g., removing leading and trailing blanks) and feature extraction (as MFCC). The MFCCs will be then fed as input to the SVM classifier. A sample will be then classified as normal or asphyxia, if the majority of its segments were classified as such. We acknowledge that machine learning is only a part of the solution. For deployment, we will built a mobile application using Flutter into which we have incorporated our current model. Our solution will allow us to think deeply about our ultimate objective of deploying more accessible diagnostic tool. It will also give us opportunity to receive feedback from clinicians and other caregivers.
(c) Attainable- Explain how you are going to achieve the prototype development objective with the available resources at your disposal.	We have already focused on the poor-resource settings so our solution won't require much resources and cost. In future we have completely planned on migrating to Google Cloud Platform so that our product can be accessed by stakeholders from not only India but other countries well. We have also future plans of introducing region specific solutions. Hence, our product would not require much changes and edits, it can be easily transform according to meet the growth and demand. Also, we are also researching on the topic, "Using Machine Learning on cardiotocography data for fetal state analysis". 2 © 2020 ZS 18 Therefore, in future our solution won't be limited to the detection of as asphyxia, we will also aim to solve other problems related with infants. As many as 34 births and 10 deaths are registered in India every minute. The number goes up to 2,062 births and 603 deaths per hour, up to 49,481 births and 14,475 deaths per day and further up to 1.5 million births and 0.4 million deaths per month.34 infants are born every minute according to an article published in the Indian Express. Our solution just takes 20 seconds to detect and predict asphyxia. So, for 34 births it would take approx. 34*20=680 seconds.

(d) Realistic- what kind of skillset of team and resources required to achieve the goal in specific time period?	Our team isn't only limited to a single discipline, it includes members from diverse field such as Electronics and Communications, Mathematics, Data Science, Finance, Market Research, IT Engineer, and Cloud/MLOps/DevOps. We all know importance of our roles in this teams. Each one of us is fluent in his or her fields and have participated in the competitions on both National and College Level. We all are well coordinated among ourselves and we keep each other motivated. The team is capable of producing a fully-fledged solution from scratch. Our solution requires Data Acquisition, Statistical Modelling and Analysis, Machine/Deep Learning, Website Development, App Development, Cloud Platforms, and Market Analysis and we all are fluent in the mentioned skills. Apart from the technical skills we all our associated with bodies such as National Service Scheme, and we have done a relevant field work being a part of NSS. During the field work we became aware of many problems which people living in poverty face in their day-to-day life, especially in semi-urban and rural area. There exists numerous problems in countries such as India, Bangladesh, Pakistan, Thailand, Kenya, Ghana, Zimbabwe, etc., and often there are no effective steps taken by industries and government either due to money problem or due to lack of resources and lack of skilled people. If by anyhow my team is able to solve some problems then we would accept that our education and experience has not gone into vain. One of our mentors always said that if you can't help humanity then all your education is of no use. So, our team is trying our best to solve one small problem so that a child can see the light of the day and should not suffer in the future. Our teams is good to go and is best placed to solve the problem.
(e) Timeline- Develop a timeline against the milestones for taking Idea/PoC to Prototype Development and (or) Commercial level/start-up stage.	Major Milestones: 1. Gather a team. 2. Decide what you want to build. Brainstorm something the world needs. The more the world needs it, the better. Our product may revolutionize the medical health industry as we know it. 3. Raise money. 4. Figure out how to scale.
	Applicability of Solution 10 Marks *(Max 50 words for each from a-e)*
(a) **Usability:** what is the usability of your innovation?*(Level of acceptance of innovation and its Features among target group)*	Our solution is unique, could potentially save a lot of lives, CryCure just requires a onetime investment, is cheaper than other artificial intelligence based healthcare solutions. Our solution, dubbed as CryCure, has a potential to become a revolutionary product in the healthcare industry. CryCure can help bring the mortality rate of infants down and will help infants see the light of the day. Also, many times Asphyxia leads to severe life-long disabilities, hence CryCure will also help in avoiding these types of long-term liability. According to a report published in The Economic Times people have long-term disabilities are just limited to being a burden on their family as told by various people in a survey. Also, these people have tough time in today's modern world. Governments need to spend a lot of money on these people which in result effects our economy too. We found 20 such studies conducted in 10 countries. These studies were predominantly from high-income countries. Although studies were heterogeneous (e.g., in terms of disability measures and cost methodologies), estimated costs were sizeable and some patterns were consistent across studies. Costs varied according to the severity of disability, life cycle and household composition. Highest costs were observed among persons with severe disabilities, and among persons with disabilities living alone or in small sized households. More quantitative evidence is needed using rigorous methods, for instance evidence based on longitudinal data and as part of policy evaluations. More internationally comparable data on disability is required for the quantitative evidence to develop, especially in low- and middle-income countries where studies are scarce. Qualitative and

	participatory research is also needed, especially to investigate unmet needs, and the consequences of extra costs. Hence, our solution not only limited to being just an idea but a fully-fledged solutions for the mentioned problems. Therefore, we think that our solution should be considered for the next round.
(b) Scalability: how your innovation will be scalable at market level.	Provide evidence to establish confidence in the proposed idea that it will likely lead to change in status quo in the relevant area when at scale? (400 words max): Already many startups exist in Indian, African, and other third world countries having which are using artificial intelligence for improving healthcare facilities, some of them are: • Founded in 2016, this is a startup based in Ghana, Mino health introduced an innovative Medical Health System to democratize duality healthcare with AI for medical diagnostics, Cloud Medical Records system for hospitals, health ministries and patients, and big data analytics for health. • Founded in 2017, based in Zimbabwe, Dawa Clinic is an Artificial Intelligence-based web-mobile platform which is aimed at facilitating remote healthcare service for pregnant women and early mothers. The App works with a self-monitoring kit that empowers mothers to receive remote maternal health. Through the App, mothers are able to monitor parameters like blood pressure, Urinary Tract Infections (UTIs), blood sugar levels, and other pregnancy-related complications. The information is wired remotely to a doctor for early intervention in case of any complications. Link: https://www.dawa-health.com/ 1 © 2020 ZS 17 The above mentioned startups have the same artificial intelligence structure and they have already acquired funding. They are also changing the social landscape. The countries like Ghana, Zimbabwe, Kenya, Bangladesh, etc have social-economic landscape worst then India and if the above startups are working well then we think that our solution will be also able to improve the social-economic landscape. Also, India has better economy and skilled engineers, doctors, data scientists when compared to the above mentioned countries. Hence, we believe that our solution will be able to lead to change in status quo in the relevant area when at scale. When our solution would be deployed at scale then it will be much beneficial and will be able to stop the chances of life-long disabilities.
(c) Economic sustainability: Explain the potential of innovation to become profitable or financially viable.	According to a report published in The Economic Times people have long-term disabilities are just limited to being a burden on their family as told by various people in a survey. Also, these people have tough time in today's modern world. Governments need to spend a lot of money on these people which in result effects our economy too. We found 20 such studies conducted in 10 countries. These studies were predominantly from high-income countries. Although studies were heterogeneous (e.g., in terms of disability measures and cost methodologies), estimated costs were sizeable and some patterns were consistent across studies. Costs varied according to the severity of disability, life cycle and household composition. Highest costs were observed among persons with severe disabilities, and among persons with disabilities living alone or in small sized households. More quantitative evidence is needed using rigorous methods, for instance evidence based on longitudinal data and as part of policy evaluations. More internationally comparable data on disability is required for the quantitative evidence to develop, especially in low- and middle-income countries where studies are scarce. Qualitative and participatory research is also needed, especially to investigate unmet needs, and the consequences of extra costs. Long-term costs for the use of resources (human and material) are included in economic calculations which ensures economic sustainability Our idea conserves resources long-term. We must live on the "returns" of the Earth's natural resources rather than consuming them. Hence we use environment friendly hardware devices by using the concepts of Nano electronics and natural sources of energy and save or dispose data using website and app development to ensure connectivity and reach in remote areas.

(d) **Environment Sustainability:** How your innovation is environment friendly or address environmental problems.	Since our product uses the APP and technology interfaces as its background it is environmentally sustainable. The challenge, however, goes beyond guiding "human friendly AI" to ensuring "Earth friendly AI". As the scale and urgency of the economic and human health impacts from our deteriorating natural environment grows, we have an opportunity to look at how AI can help transform traditional sectors and systems to address climate change, deliver food and water security, build sustainable cities, and protect biodiversity and human wellbeing.
(e) Is there any Intellectual Property (IP) Component associated with innovation? if yes, explain.	No
Define the potential market size (in terms of INR) and target customers. *(Max 100 words)*	

Themes:

1. Healthcare & Biomedical devices.
2. Agriculture & Rural Development.
3. Smart Vehicles/ Electric vehicle/ Electric vehicle motor and battery technology.
4. Food Processing.
5. Robotics and Drones.
6. Waste management.
7. Clean & Potable water.
8. Renewable and affordable Energy.
9. IoT based technologies (e.g. Security & Surveillance systems etc)
10. ICT, cyber physical systems, Block chain, Cognitive computing, Cloud computing, AI & ML.

9 stages of TRL:

TRL 0 : Idea. Unproven concept, no testing has been performed.

TRL 1 : Basic research. Principles postulated observed but no experimental proof available.

TRL 2 : Technology formulation. Concept and application have been formulated.

TRL 3 : Applied research. First laboratory tests completed; proof of concept.

TRL 4 : Small scale prototype built in a laboratory environment ("ugly" prototype).

TRL 5 : Large scale prototype tested in intended environment.

TRL 6 : Prototype system tested in intended environment close to expected performance.

TRL 7 : Demonstration system operating in operational environment at pre-commercial scale.

TRL 8 : First of a kind commercial system. Manufacturing issues solved.

TRL 9 : Full commercial application, technology available for consumers.

For any Query:

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