Projects in the Robotics and Artificial Intelligence Fields 2021–2022
About NEDO

- NEDO is a national research and development agency that creates innovation by promoting technological development necessary for realization of a sustainable society.
- NEDO acts as an innovation accelerator to contribute to the resolution of social issues by developing and demonstrating high-risk innovative technologies having practical application.

NEDO’s Missions

Addressing energy and global environmental problems

NEDO actively undertakes the development of new energy and energy conservation technologies. It also conducts research to verify technical results. Through these efforts, NEDO promotes greater utilization of new energy and improved energy conservation. NEDO also contributes to a stable energy supply and the resolution of global environmental problems by promoting the demonstration of new energy, energy conservation, and environmental technologies abroad based on knowledge obtained from domestic projects.

Enhancing industrial technology

With the aim of raising the level of industrial technology, NEDO pursues research and development of advanced new technology. Drawing on its considerable management know-how, NEDO carries out projects to explore future technology seeds as well as mid- to long-term projects that form the basis of industrial development. It also supports research related to practical application.

Three Initiatives Based on NEDO’s Fourth Five-Year Plan

1. Managing Technological Development to Utilize Results in Society
2. Fostering Technology-Based Startups
3. Determining the Direction of Mid- to Long-Term Technology Development

Positioning of NEDO as an Innovation Accelerator

In order to contribute to the resolution of social issues, NEDO formulates technology strategies and project plans and, as part of its project management, establishes project implementation frameworks by combining the capabilities of industry, academia, and government. NEDO also promotes technology development by carrying out, evaluating, and allocating funding to promising projects to accelerate the practical application of project results.
Missions and Activities

Message from the Director General

The explosive spread of COVID-19 has largely affected global social and economic activities and brought unprecedented changes to our daily lives. On the other hand, as symbolized by the term DX, digital technologies are rapidly spreading and being applied in all industries and new products, services, and business models are being created. We have high expectations for robot and AI technologies to realize safe and secure living and accomplish projects, especially as remote, non-face-to-face, and non-contact situations are becoming more important in the pandemic.

NEDO has worked on AI from early on and started researching and developing a robot intended to work alongside humans in 1998. We have worked on not only intelligent robots but also the development of basic AI technologies to solve various social issues.

Now that we must live with COVID-19, we will continue pursuing the cutting-edge development that leads to the resolution of social issues by leveraging the results from past initiatives and endeavor to ensure the safety and security of our “new normal” with the results that come from that development.

In addition, we are developing technologies in new fields including automated driving, small unmanned aerial vehicles (drones), and electric aircraft based on the management experience we have gained while developing robots and AI.

We are committed to promoting research and development activities from a long-term standpoint in these cutting-edge fields to utilize developed technologies in society.

This brochure briefly summarizes initiatives in NEDO’s robot and AI projects. It would be highly appreciated if you would take the time to read it.

March 2022

Director General, Robot and Artificial Intelligence Technology Department, NEDO
HAYASHI Shigekazu
Introduction of Robot and Artificial Intelligence Technology Department

NEDO’s Robot and Artificial Intelligence Technology Department is researching and developing state-of-the-art robots and artificial intelligence (AI) that can be used in various situations in society and drones, aircraft, automated driving, and other technologies based on that technology base to contribute to building a smart society. We are trying to utilize new technologies in society while conducting research and development from a long-term standpoint.

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Main Projects

Robots

- Project to Construct a Basis for Research and Development of Innovative Robots
- Technology Development to Realize a New Delivery Service Using Self-Driving Robots
- Development of Integrated Core Technologies for Next-Generation AI and Robots
- Realization of a Smart Society by Applying Artificial Intelligence Technologies
- Technology Development Project on Next-Generation Artificial Intelligence Evolving Together with Humans
- Development of AI-Based Innovative Remote Technologies
- Strategic Innovation Promotion Program (SIP): Big-data and AI-enabled Cyberspace Technologies

AI

- Research and Development of Advanced Aircraft Systems for Practical Application
- Drones and Robots for Ecologically Sustainable Societies Project
- Technical Base Development for Secure and Reliable Drones
- Strategic Innovation Promotion Program (SIP): Automated Driving for Universal Services

Mobility

- Green Innovation Fund Project
- Human Resources Development
- World Robot Summit

SIP: Cross-Ministerial Strategic Innovation Promotion Program
## Chronology of Projects

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<td>❍ Drones and Robots for Ecologically Sustainable Societies Project</td>
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* SIP: Cross-Ministerial Strategic Innovation Promotion Program (Cross-ministerial Strategic Innovation Promotion Program)
Policies and Milestones for Robot and Artificial Intelligence Technology Department

**2014**
- April: Robot and Machinery System Technology Department established.

**2015**
- February: Japan’s Robot Strategy (issued by Headquarters for Japan’s Economic Revitalization).

**2016**
- March: Technology strategy formulated for AI and robotics fields.
- April: Renamed to Robot and Artificial Intelligence Technology Department.
- April: AI Social Implementation Promotion Division established.

**2017**
- June: Revisions to Japan Revitalization Strategy 2015: Productivity revolution through investment in the future (approved by Cabinet).
- June: Artificial Intelligence Technology Strategy formulated.

**2018**
- First Tri-Ministerial AI Symposium.

**2019**
- April: Concluded agreements with Minamisoma City regarding development of robot-related human resources.
- October: World Robot Summit Team established.

**2020**
- October: World Robot Summit 2018 held.

**2021**
- March: The 6th Science and Technology Innovation Basic Plan (approved by Cabinet).
- June: AI Action Plan formulated.

**2014-2021 Milestones**

- May 2015: OECD Ministerial Council Meeting, Keynote address by Prime Minister Abe.
- February 2015: Japan’s Robot Strategy (issued by Headquarters for Japan’s Economic Revitalization).
- April 2014: Robot and Machinery System Technology Department established.
- June 2016: World Robot Summit Team established.
- October 2016: World Robot Summit 2018 held.
- May 2015: OECD Ministerial Council Meeting, Keynote address by Prime Minister Abe.
- February 2015: Japan’s Robot Strategy (issued by Headquarters for Japan’s Economic Revitalization).
- April 2014: Robot and Machinery System Technology Department established.
- June 2016: World Robot Summit Team established.
- October 2016: World Robot Summit 2018 held.
- May 2015: OECD Ministerial Council Meeting, Keynote address by Prime Minister Abe.
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- April 2014: Robot and Machinery System Technology Department established.
- June 2016: World Robot Summit Team established.
- October 2016: World Robot Summit 2018 held.
Project to Construct a Basis for Research and Development of Innovative Robots

**Project Overview**

This project is aimed to realize robots that can be applied in fields where the introduction of robots has not been progressing, such as the production of multiple products in small quantities, by promoting the development of elemental technologies important for industrial robots. This project is also intended to develop technologies by going back to the underlying science in addition to improving or enhancing existing technologies, make innovations, for example, by adopting technology seeds in different fields where robots have not been utilized, and strengthen international competitiveness.

1. **General-purpose operation planning technology**
   Establishment of a database of the technology involved in grasping/holding movements and the work targets of industrial robots and development of the necessary logics and algorithms to optimize work plans using the established database to verify robot system development.

2. **Handling-related technology**
   Development of an end effector that enables linkage with databases and other devices equipped with sensing technologies, and a robot hand that can stably grasp/hold various targets including amorphous objects.

3. **Remote control technology**
   Development of signal transmission criteria for 5G communications and other applications to ensure safe and secure control of visual, force sense, voice and other kinds of data, even if there is communication delay or disturbance, and a communication method that reduces the fatigue of operators through quantitative evaluation of the influence of operational delay on the human senses.

4. **New robot material technology**
   Evaluation/examination of the applicability of resins and composite materials by establishing specifications that are mainly necessary for robots, such as strength, rigidity, heat-resistance and durability, and development of technology to integrate pressure, vibration, temperature and other sensor materials into robots and to realize wireless power supply and self-power generation.

Reference: ROBOT Industrial Basic Technology Collaborative Innovation Partnership [https://robocip.or.jp/](https://robocip.or.jp/)
Technology Development to Realize a New Delivery Service Using Self-Driving Robots

**Project Overview**

NEDO is developing self-driving robot technology to realize remote, non-face-to-face and non-contact last-mile distribution (deliveries from logistics bases to residences and designated destinations). In this project, demonstration experiments to operate developed self-driving robots in zones such as housing complexes, downtown areas, commercial facilities and industrial areas, and on some public roads.

Due to the influence of COVID-19, deliveries from logistics bases to residences and designated destinations (last-mile logistics) have been disrupted as demands for door-to-door deliveries have increased, but infection-related shortages of drivers are experienced. Since this situation is expected to continue, early realization of new delivery services using automatically operating robots is required as a measure to deal with increased needs for “remote, non-face-to-face and non-contact” deliveries and shortage of drivers in last-mile logistics.

Against such a backdrop, New Energy and Industrial Technology Development Organization (NEDO) will launch a technological development project on automatically operating robots, to strengthen supply chains realizing such robots early and maintaining logistics services even in emergencies, as well as to vitalize related markets. With this project, a series of demonstration experiments to operate developed automatically operating robots in housing complexes, downtown areas, commercial facilities and industrial areas, and on some public roads, will be conducted from November. Analysis and examination of efforts toward social receptivity will also be conducted for the realization of new delivery services using automatically operating robots.

This project will also involve collaboration with the Government-Private Council for the Realization of Deliveries Using Automatically Operating Robots* (established in September 2019), and information related to the following matters will be provided to the Council.

- Clarification of use cases playing core roles in commercialization
- Safety evaluation concerning the specifications of automatically operating robots and the establishment of a system for their safe operation
- Examination/establishment of systems, laws, regulations, etc. concerning the utilization of automatically operating robots

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**Description of Research and Development**

PM = Project Manager

**PM**

KAMIYAMA Kazuto

Chief Officer

Technology Development to Realize a New Delivery Service Using Self-Driving Robots

Project period FY 2020 – FY 2021

Budget 25 million yen (FY 2021)
Development of Integrated Core Technologies for Next-Generation AI and Robots

This project involves the conduct of research, development, and demonstration to reduce the time required for the deployment of artificial intelligence technologies to 1/10th of the current situation in the focused areas of productivity and mobility, for which early social implementation of artificial intelligence technologies is required. This project is also aimed to establish common base technologies to enlarge the application fields of artificial intelligence technologies. This project promotes these themes with agile development methods to accelerate social implementation of AI to capture new markets. Improved productivity brought about by the deployment of artificial intelligence technologies is expected to reduce energy consumption and CO₂ emission.

PL = Project Leader; PM = Project Manager

PL: HIGUCHI Tomoyuki (Professor of the Department of Data Science for Business Innovation, Faculty of Science and Engineering, Chuo University)
HORI Koichi (Professor of the School of Engineering, The University of Tokyo)

Project Overview

This project involves the conduct of research, development, and demonstration to reduce the time required for the deployment of artificial intelligence technologies to 1/10th of the current situation in the focused areas of productivity and mobility, for which early social implementation of artificial intelligence technologies is required. This project is also aimed to establish common base technologies to enlarge the application fields of artificial intelligence technologies. This project promotes these themes with agile development methods to accelerate social implementation of AI to capture new markets.

R&D item 1:
Conduct agile research, development and demonstration for the implementation of (1) business analysis, identification of issues and data collection/accumulation/processing, (2) development and application of artificial intelligence modules, (3) demonstration in actual fields and (4) establishment of an evaluation system and feedback on the development/application of new artificial intelligence technologies using productivity, spatial movements and other issues targeting priority areas.

R&D item 2:
Conduct development of “technologies to accelerate the deployment of artificial intelligence technologies” that involve business inventory, analysis and improved efficiency related to the deployment of artificial intelligence; “artificial intelligence technologies that assist the generation of hypotheses” to realize a management simulation system that can identify the relationship between objective variables and generate/evaluate/propose advanced hypotheses; and “artificial intelligence technologies supporting work-related decision-making” that automatically identify problems and points to improve and support non-expert judgments by systematizing tacit knowledge on manufacturing technology information and modeling skilled engineer decisions.

Reference: Introduction of Project: Development of Integrated Core Technologies for Next-Generation AI and Robots
https://www.nedo.go.jp/content/100905869.pdf
Realization of a Smart Society by Applying Artificial Intelligence Technologies

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<th>Project period</th>
<th>FY 2018 – FY 2022</th>
<th>Budget</th>
<th>1.79 billion yen (FY 2021)</th>
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**PL**

TSUJII Junichi (Director, Artificial Intelligence Research Center, National Institute of Advanced Industrial Science and Technology)

KAWAKAMI Takayoshi (Partner/Managing Director, Industrial Growth Platform, Inc.)

**Project Overview**

This project concerns the conduct of research and development to promote the social implementation of artificial intelligence technologies in the three high-focus areas of the strategy of artificial intelligence technologies of productivity, health, medical care, and welfare; and mobility.

This project specifically concentrates on research, development, and demonstration for the realization of a smart society combining cyber- and physical space with the use of artificial intelligence modules and data-acquisition sensor technologies that have been researched, developed, and deployed so far, and also applying research and development infrastructures.

**Description of Research and Development**

- **Data collaboration analysis**
  Establishment of a data base for large-scale data analysis by solving the difficulty of cross-disciplinary data sharing

- **Value chain efficiency AI system for plant factories etc.**
  Creation of next-generation agriculture through improvement in value chain efficiency

- **Smart food chains**
  Contribution to the expansion of markets and creation of new industries through overall optimization of food chains using AI

- **Stroke prediction system**
  AI system that can determine the risk of cerebral aneurysm rupture, enabling appropriate diagnosis/treatment

- **AI smart coaching technology**
  Realization of a smart society where people can have a long healthy life

- **AI assistance for engineering antibody mimic**
  Contribution of the development of new drugs by constructing a platform for efficient development of protein-based molecularly-targeted drugs

- **AI for pharmaceutical formulation design**
  Proposing multi-purpose optimized formulation in terms of effectiveness, safety and quality

- **3D maps for transportation**
  Realization of eco systems based on 3D map information

- **Innovative drone AI technology**
  Realization of drones that “do not fall/are safe even if they fall” with AI technology

- **Explainable AI for decision basis**
  Establishment of a persuasive AI that provides a sense of safety, by verbalizing the grounds for judgment

- **Autonomous decentralized traffic signal system**
  Realization of efficient/smooth traffic flows with autonomous decentralized signals using AI

Reference:

Introduction of Project: https://www.nedo.go.jp/content/100906019.pdf (Japanese)

NEDO channel: https://www.youtube.com/watch?v=QXiOT2A0L5g&list=PLZH3AKTCrVsXNjtM2MLPYDfNOvS01AcL (Japanese)
Technology Development Project on Next-Generation Artificial Intelligence Evolving Together with Humans

Project Overview

While AI technologies have increasingly been applied to work and tasks in various fields, AI application in fields that have a significant socioeconomic influence, such as manufacturing, medical care and transportation, is still limited. To expand the application in such fields, it is important to realize an “AI system evolving together with humans” by enabling people and AI to share roles and cooperate from their respective areas of expertise and grow and evolve together.

In this project, core technologies for AI systems evolving together with humans will be developed, methods for AI system evaluation/management will be established to facilitate the social application of those technologies, and technologies that can easily be established/introduced will also be developed.

Description of Research and Development

Research and development of basic technologies for AI systems that grow and evolve together with humans is conducted towards the smooth social application of those AI systems.

https://www.cpsec.aist.go.jp/achievements/aiqm/

Reference of the α version of the machine learning system quality assessment test bed (with limited functions)
https://www.aist.go.jp/aist_j/press_release/pr2020/pr20201118/pr20201118.html
Development of AI-Based Innovative Remote Technologies

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<td>FY 2021 – FY 2024</td>
<td>470 million yen (FY 2021)</td>
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PL = Project Leader; PM = Project Manager

HARADA Tatsuya (Professor of The Research Center for Advanced Science and Technology, The University of Tokyo)

Project Overview

The need for remotization for social and economic activities that are free of spatial and temporal constraints such as telework and online meetings is rapidly increasing in response to the spread of COVID-19. However, the effects of remotization on productivity improvement are limited. This is because of a problem with remotization that has come to light, namely, that the situation at the remote locations cannot be known precisely. In particular, remotization is not sufficiently spreading in labor-intensive, mainly face-to-face work environments, because information critical to conduct work cannot be transmitted. As a result, these types of businesses have experienced an economic shock from suspension of business activities.

To spread the remotization of social and economic activities to a wider range of fields and improve productivity, the project is aimed at establishing an innovative remote technology base that allows the user to grasp the situation in the field remotely as well as, or even better than an actual visit by estimating the situation at the remote place and making it so that the other party can effectively recognize information, not only visually and aurally, but also using other senses such as through haptics.

Description of Research and Development

The following five research and development themes are addressed as part of this project to develop the following two technical bases; the situation estimation AI system to estimate the situation in a remote environment in a sophisticated way, and the AI system that presents the situation through advanced XR to effectively convey information.

1. Development of bidirectional remote tactile communication AI system using ultrathin haptic MEMS
   Reference: https://www.aist.go.jp/aist_j/aistinfo/bluebacks/no33/

2. Development of remote palpation system by making Contact Reality
   Reference: https://www.nedo.go.jp/content/100937782.pdf

3. Building a multisensory XR-AI technology base and linkage of mutual care with health guidance for remote rehabilitation
   Reference: https://unit.aist.go.jp/harc/nedo-xrai-healthcare/

4. Research and development of an innovative drone remote technology to realize avatars in the sky using AI and XR
   Reference: https://www.nedo.go.jp/content/100937784.pdf

5. Emotion Embodied Avatars: Novel Remote Communication with Motion Unit AI
   Reference: https://www.icd.riec.tohoku.ac.jp/project/3D-interaction/project_eea_e.html

We conduct research and development setting the establishment of a technical base as the final goal of the project and assuming use cases.

Every field in society supports remotization after the end of the project because the established technical base is applied.
Strategic Innovation Promotion Program (SIP): Big-data and AI-enabled Cyberspace Technologies

Project Overview

It is essential to create a system in which cyberspace and physical space are interconnected to realize Society 5.0. However, there are still various development-related factors and issues that need to be resolved. This project will particularly establish “human interaction platform technology,” “inter-domain data exchange platform technology,” and “AI-based automatic negotiation platform technology,” the subcategories of “cyberspace platform technology,” which will conduct social implementation of cyber-physical systems utilizing big data and AI.

Description of Research and Development

(1) Human interaction platform technology
(1-1) Cognitive interaction support technology: Advanced interaction support technology that collects and structures verbal and non-verbal data related to human cognition and behavior to enable AI to support and enhance human interaction, and supports situational decision-making and communication with others based on individual needs.
(1-2) Advanced multimodal dialogue technology: Advanced dialogue processing technology that enables multimodal memorization, integration, cognition, and judgment for human-AI collaboration
(1-3) Learning support technology: Technology that individually optimizes education and learning activities by collecting big data related to teachers and students from educational sites and combining them with AI
(1-4) Nursing-care support technology: Technology that reduces the burdens on both caregivers and care recipients by collecting big data related to them from nursing care sites and combining them with AI

(2) Inter-domain data exchange platform technology: Inter-domain data exchange platform technology for inter-domain data sharing/utilization and establishment of a system to promote distributed and federated inter-domain data exchange for one-stop provision of these data.

(3) AI-based automatic negotiation platform technology: Technology for automatic negotiation and collaboration between multiple AI platforms

Research and Development of Advanced Aircraft Systems for Practical Application

Project Overview

Aircraft components other than the basic structure (e.g. fuselage, wings, and similar sections) and engines are collectively called “systems.” There are many system types, such as flight control, air-conditioning, electric, hydraulic and fuel. They have a direct impact on the function and performance of aircraft, and are indispensable elements of aircraft operation. Demands for passenger aircraft are expected to grow dramatically with a doubling of the number over the next 20 years. Aircraft systems, which account for approximately 40% of the total aircraft value, are thus very important.

To take advantage of Japanese system manufacturers’ technical competence to enter the system market on a full scale, and to increase market share, this project is intended to develop lightweight, low-cost, and safe systems for next-generation aircraft that can enter service from the mid-2020s. Thus, Japanese system manufacturers will enhance their competence as system integrators to become Tier 1 manufacturers, and contribute to the further development of the Japanese aircraft industry.

Description of Research and Development

High-efficiency, high-output electric propulsion system

A high-efficiency, high-output density electric propulsion system using superconductor technology. It will be driven by electricity generated with a gas turbine. Superconductor equipment will be cooled by LN2 using the cold heat of the fuel (LH2, etc.). Basic and systematization research will be promoted for superconductor power generators/cables/motors, low-temperature operating inverters, cooling systems and other devices, with the focus on trial production and evaluation of 500 kW-class fully superconducting motors and 1-MW superconductor propulsion systems, with the aim of realizing electric engine systems for 100- to 200-passenger aircraft.

Lightweight batteries

Design of cells and battery control systems and evaluation of prototypes will be conducted to develop battery systems required for electric aircraft. Conversion to electric aircraft engines is expected in the future to reduce the environmental burden and other purposes, but existing batteries are still too heavy for use on a practical level. To realize practical energy level of lightweight batteries for aircraft, research and development of batteries using sulfur as the positive electrode active material will be promoted. Particular effort will be made in the research and development of porous carbon particles containing sulfur.

Electric hybrid system

A new-generation electric engine system to replace the existing propulsion systems will be applied to realize dramatically lower fuel consumption and environmental burden. In addition to measures against global warming, the system will contribute to the improvement of the safety and operability of moving vehicles utilizing the improved controllability realized by more sophisticated engine systems. Materials and structures that will enable high-voltage use at high altitudes, a specific challenge concerning the introduction of electric propulsion, will be identified, and on-land demonstration of a next-generation electric engine system will be conducted with the focus on electric control and heat/air management systems.

Motor control system for propulsion

A globally competitive product will be developed by including multiphysics optimum analysis in design and applying superior element technologies to the motor inverter to create a high-power high-density air-cooled motor inverter system. Consideration for certification will also be conducted to realize the motor control system for propulsion.
Drones and Robots for Ecologically Sustainable Societies Project

Project Overview

It is hoped that the use of drones and robots will help conserve energy, particularly in the logistics sector where there is demand for energy-efficiency due to increased deliveries of small parcels and lighter load ratios, as well as in the infrastructure inspection sector where there is an urgent need to reduce the use of resources by ensuring longer live-spans at infrastructure facilities through effective and efficient inspections.

This project aims to encourage the development of drones and robots that can be used in sectors such as logistics, infrastructure inspections, and disaster response, while also establishing systems and conducting test flights in preparation for their increased utilization.

Domestic and overseas trends of the systems, technologies, standardization, and other aspects of flying cars will be also surveyed.

Description of Research and Development

① Development of performance evaluation methods for robots and drone devices

(1) R&D of performance evaluation methods

Establish performance evaluation methods for each sector and robot type, for various types of robots.

(2) R&D to improve energy-saving performance

Develop technology for energy-efficient systems required for increasing the continuous operating time of various types of robots.

(3) R&D on the energy management of UAV

Research and develop peripheral systems such as the energy management system required for increasing the continuous operating time of various types of robots.

② Development of UAV Traffic Management System and collision avoidance technologies

(1) Development of UAV Traffic Management System

Develop various functions and systems to ensure that UAVs can be operated safely, based on the Traffic Management System developed under the project which include functionalities for information provision, traffic management and integrated traffic management.

(2) Development of UAV collision avoidance technologies

Develop technologies that enable UAVs to detect objects either on land or in midair, so that they can avoid collisions when flying in real time.

③ Promotion of international standards related to robots and drones

(1) De jure standards

While cooperating on the international level, conduct studies to identify trends among international organizations and other groups around the world promoting standardization, and carry out activities linking the results of this project to international standards.

(2) De facto standards

Technology is being developed at tremendous speeds and robots are the key to developing de facto standards, so Japan will gather information regarding the latest global technology trends and promote methods to accelerate technology development using rules formulated in Japan.

④ Study on leading research on flying cars

For flying cars, extract elements that must be technologically verified by 2025, create verification items and a demonstration plan, and organize items to be technologically verified and other items to be realized automatically and autonomous flights and a dense flight schedule after 2025.

Technical Base Development for Secure and Reliable Drones

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<th>FY 2020 – FY 2021</th>
<th>Budget</th>
<th>580 million yen (FY 2021)</th>
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Project Overview

There are increasing needs of secure and reliable drones by central and local governments, public and commercial service sectors for such purposes as disaster damage investigation, inspection of aged infrastructures, and monitoring/searching human or harmful animals. To meet these needs, NEDO supports the design/development of a safe and secure standard drone, the improvements of its performance and mass production processes to cultivate Japanese drone industry and enhance its business ecosystems.

Description of Research and Development

1. Design/development of a standard drone
   Design/develop a small and easy-to-use standard drone aircraft to realize high-performance aerial photography, and publish main modules interfaces to realize connectivity to the higher-performance components.

2. Design/development of a standard flight controller
   Design/develop a flight controller and its flight supporting application modules to realize high performance/operability of flight, and publish flight controller APIs to enable drone control using third-party applications.

3. Development and implementation of high-level security technologies for drones
   System development compliant to the Basic Act on Cybersecurity ensuring resistance to the hijacking of aircraft, protection of flight log data and aerial photo images, and security of cloud-stored data.

4. Support for design/development of higher performance components
   Extension of flight time by energy saving technologies and improvements of batteries and motors/ESCs, advancements of aerial photographing functions through improvements of gimbals, cameras and image transmission technologies, and noise reduction through the improvements of propellers.

5. Support for design/development of mass production and life-cycle support systems
   Support for design/development of mass production and maintenance systems enabling safe and secure operations throughout the lifecycle of drones to ensure government procurement and the other mission-critical operations at the early stage after the project.
Strategic Innovation Promotion Program (SIP): Automated Driving for Universal Services

<table>
<thead>
<tr>
<th>Project period</th>
<th>FY 2018 – FY 2022</th>
<th>Budget</th>
<th>3.12 billion yen (FY 2021)</th>
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</thead>
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<tr>
<td>PD</td>
<td>KUZUMAKI Seigo (Company Fellow, Advanced R&amp;D and Engineering Management Division, Toyota Motor Corporation)</td>
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</table>

PM = Program Director; PD = Project Manager

Project Overview

There are high hopes for the change in society that the realization of automated driving will bring about. This project is intended to ensure that industry, academia and government work together to promote the research and development of automated driving technology in the areas of cooperation, validate the technology through field operational tests and other activities, and plan how to use it in society with an aim to reduce traffic accidents and traffic congestion and resolve social issues such as securing mobility in underpopulated areas, alleviating driver shortages concerning logistics and transportation services for the realization of Society 5.0. NEDO supports the entire project as an administrative organization.

In this project, research and development in the areas of cooperation are promoted in the following four fields.

I. Development and evaluation of automated driving systems (FOTs: Field Operational Tests)  
   Build the driving environment required for automated driving including the road transportation infrastructure in the Tokyo waterfront area and local areas. Industry, academia and government will conduct field operational tests together to verify the technological specifications of infrastructure and examine continuous local profitability with the help of local residents, local governments, and other parties.

II. Development of core technology for the practical use of automated driving  
   Conduct fundamental research and development including the use of geographical data in the automated driving field, creation and distribution of transportation environment information, safety assessment technology in virtual space, detection of external threats and actions against them to ensure cybersecurity, and consideration of the optimum communication method for each automated driving use case.

III. Fostering the public acceptance of automated driving  
   To spread automated driving, clarify the value and issues, distribute information for correct public understanding, and measure the effects of the distribution of that information. In addition, assess the social and economic impact of automated driving and conduct studies to solve social issues such as reduction in traffic accidents and support for people with limited mobility.

IV. Strengthening international collaboration  
   Promote insight sharing, joint research, and human interaction with other countries where automated driving is being studied and the environment for practical application is being established including Germany and the EU to ensure industrial competitiveness and gain a leading position in international standards in the above three fields.

Website on automated driving: https://en.sip-adus.go.jp/

Automated driving levels by SAE*

* Society of Automotive Engineers, a standardization body in the United States
Green Innovation Fund Project

Overview

In October 2020, Japan declared that it would be carbon neutral by 2050 and set a goal to reduce emissions of greenhouse gases to zero in total by 2050. This goal significantly advances the policy that the government already had and requires extraordinary efforts to achieve. We must largely accelerate our current efforts through structural reform in the energy and industry sectors and innovation based on bold investments.

For this purpose, a fund of 2 trillion yen has been established as the Green Innovation Fund Project at NEDO. The organization will share specific ambitious goals in the public and private sectors, and will continuously support companies and other entities that work on these as management issues starting from research and development to demonstration and social implementation for 10 years.

The Robot and Artificial Intelligence Technology Department promotes the following three areas.

- **Development of next-generation batteries and next-generation motors**
  This project is aimed at strengthening the industrial competitiveness of the technical base, batteries, and motors that support future electrification of automobiles and reinforce the supply chain and value chain by solving technological issues to improve the performance of batteries and motor systems, reduce costs, increase sophistication on the material level, save resources, and practically apply advanced recycling technologies.

- **Development of the in-vehicle computing simulation technology to save energy in EV and other vehicles**
  This project is aimed at conducting research and development for thorough energy saving, guaranteeing the performance for level 4 automated driving with in-vehicle computing (automated driving software sensor system), and builds the simulation base to accelerate and advance the development of EVs and other vehicles in the supply chain as a whole, assuming a distributed architecture (edge processing orientation).

- **Building a smart mobility society**
  This project is aimed at building a smart mobility society where the energy use, traffic management, and other activities of individual businesses and society as a whole are optimized by leveraging simulation technologies toward decarbonization in the transportation sector. Data on EVs, FCVs and other vehicles when used for commercial purposes are collected and used for traffic management and integrated energy management. In addition, simulation related to the optimum allocation of charging and refueling infrastructure and other matters is researched, developed, and demonstrated.

Reference: Special website for the Green Innovation Fund Project  https://green-innovation.nedo.go.jp/ (Japanese)
Workshop aiming at the vitalization of human resource development/exchange and technical research to maintain, disseminate, and improve the common robot software technologies which can accelerate system integration

NEDO allows a wide range of robot engineers to leverage common software technologies for robots using open source software (OSS) and holds a workshop aiming at the vitalization of human resource development/exchange and technical research to maintain, disseminate, and improve the common robot software technologies which can accelerate system integration to maintain and improve the software on a continuous basis.

The workshop features not only for the education of common robot software technologies, and also for establishing systems for opportunities of human resource exchanges related to common robot software and constant maintenance/improvement of the technologies.

Reference: https://robo-marc.github.io

Courses to develop ROS human resources for small and mid-sized construction companies

As Japanese small and mid-sized construction companies face a reduction in the size of their workforce and aging of workers, the need for work automation at civil engineering and construction sites is high. However, small and mid-sized construction companies cannot afford to invest in state-of-the-art automated construction machines. To solve this issue, low-cost automation of existing construction machines through retrofitting and use of open ROS (Robot Operating System) intelligent software has been studied and developed.

In this project, an educational program is organized to develop human resources that can start working immediately and can apply their knowledge to various construction sites through acquisition of autonomous robot technologies for construction work, mathematical knowledge on intelligent software, and knowledge on how to leverage the ROS and intelligent software as well as field work. As a result, small and mid-sized construction companies can develop human resources who can leverage intelligence software and an environment for a virtuous circle of research and development and field use is established.

Workshop on activation of human resource development/exchange and research to spread and develop delivery services that use self-driving robots

NEDO will conduct a human resource development project to realize a new delivery service that uses self-driving robots. We will organize results obtained from the “Technology Development to Realize a New Delivery Service Using Self-Driving Robots” project and release them at seminars and on other occasions to provide information related to matters such as the performance required to ensure safety and guidelines for improving social acceptability for businesses and other organizations that are making plans for a delivery service that uses self-driving robots. We also organize human interaction to accelerate the realization of the service and conduct peripheral research on the operational safety standards and how to verify robot safety and so on.
World Robot Summit (WRS)

Project Overview

World Robot Summit (WRS) hosted by METI and NEDO is a competition and exhibition event that gathers the world’s wisdom on robots, with an eye on realizing a world in which humans and robots coexist and collaborate. WRS2020 to be held in FY 2020 was postponed until FY 2021 due to the spread of COVID-19. The Aichi Competition was held in September and the Fukushima Competition was held in October.

WRS2020 Aichi Competition
(September 9 to 12, 2021, Aichi International Exhibition Center)
Competitions in the manufacturing, service, and junior categories

WRS2020 Fukushima Competition (October 8 to 10, 2021, Fukushima Robot Test Field)
Competitions in the infrastructure and disaster recovery categories

WRS VIRTUAL
An avatar guides visitors through the 3D space where they can see WRS competitions and exhibit booths of sponsors.
