# Hull Robotics Society: InMoov Humanoid Robot Project

# Project Proposal

Following document represents the project proposal and analysis for the development of a InMoov robotics platform to be constructed by the Hull Robotics Society for the Hull University Computer Science Department.

## DSC_0036bis2Background

InMoov is a humanoid robotics platform developed by French sculptor Gaël Langevin that is reproducible on standard small format 3D printers. The components used within InMoov are standard parts that can be obtained from various sources and feature Arduino and similar microcontrollers to control the motors and sensory packages that can be added to the platform. The platform itself is open-source and various improvements and additions to the original design have been produced to increase the robot’s functionality some of which will be outlined within this proposal.

## Design Analysis

The following is an analysis and description regarding the design and function of the InMoov platform. Please note that this is an analysis of the standard InMoov released on <https://inmoov.fr> and doesn’t include analysis on alternative parts or sensors. InMoov is made up of 8 main parts (not including the finger starter) outlined here <https://inmoov.fr/build-yours/>

### Hand and Forearm

The platform features two full arms and hands featuring 16 DOF in each hand featuring 5 fingers and a thumb as well as 5 DOF for each arm. The fingers are connected using fishing wire attached to servos enclosed in the forearm. The fingers and thumb attach to the hand assembly which connects to the wrist mechanism allowing for hand rotation. All assemblies then connect to the forearm which contains all the servos required to moving the fingers utilising fishing wire.

Given the ease of construction and low cost, the design for the hand and forearm is very impressive producing an accurate and compact hand with a high degree of movement. There are several shortcomings however mainly due to the nature of how the fingers are actuated, the use of wire does greatly limit its strength and potential positional accuracy. The wrist featuring only rotation and not roll will also limit the movement ability of the robot. Overall, the arm is able to carry a total payload of 5kg before structural limits of the 3D printed parts are reached.

### Bicep

The bicep attaches the forearm and hand assemblies to the shoulder and torso. It also includes the elbow joint allowing elbow actuation. This actuation includes rotation and the ability to move the hand in toward the torso and out. It does however require modifications of the servo motors to offset the potentiometer to track joint positions.

There may be potential issues with the use of 3D printed gears as the plastic may wear down with continuous use so parts may require replacements in time. The use of suitable grease and lubricants shall be used to improve the performance and longevity of the 3D printed parts.

### Shoulders and Torso

The torso is the centre base of the entire robot and contains the assemblies needed to connect the head and the arms. It also contains area for the main controllers and computer systems needed to control the robot. The power distribution systems are also included in the main torso such as the batteries and charging systems. The Main sensors are also housed here (to later be outlined). The torso also contains actuation with some hip rotation from the low stomach as well as the ability to move its core to lean from left to right.

### Head

The head assembly includes both the main head assembly and the neck which connects to the torso. Included in the head is the eye mechanisms that allow for full movement of both eyes and with the additions of cameras can allow for vision with a pan and tilt system utilising the eye movement mechanism. There is also a mechanism that allows the jaw to open which would mainly be used when utilising speech synthesis for the robot to provide visual feedback to the user. The head is capable of tilting up and down as well as turning left and right providing a suitable range of motion.

## Goals

Below specifies the goals or aims of the project in order to measure success. This is not a list of deliverables more an outline as to what this project will provide both to students and the department

The creation of the platform alone will form a dynamic teaching tool providing those involved with knowledge in:

* Manufacturing techniques- mainly 3D printing
* Electronics – Servos, LEDs etc
* Using Microcontrollers – Arduino, Teensy etc
* Programming Robotic systems

There could also be lessons taken from its construction of a more project-based nature such as working in teams and product management such as parts procurement and project scope which would provide greater employability skills outside of academic environments.

With the platform completed the department would have a very impressive humanoid robot to use for developing future projects for students mainly in the field of Human Robot Interaction (HRI) as well as a statement piece for open days to entice prospective students as the platform will be able to demonstrate the facilities available from manufacturing to programming.

Students themselves would be able to develop software and projects that utilise the features of the platform and if ROS integration is included within the robot’s software packages could even be integrated with other robotics platforms.

Outside of the department the use of a platform such as InMoov could even be extended. Due to its origin as an opensource prosthetic limbs crossover with departments such as medical engineering could prove beneficial both in analysing the current arms and potentially proposing new additions and improvements.

It is perhaps best to treat this project as the development of platform that can be used as a testbed for future projects and packages.

## Project Analysis

In order to ensure efficiency of the project a detailed plan regarding its operation must be made. This full plan will be created after the project is confirmed and green lit, but a basic outline will be discussed below.

Due to the modularity of the platform sections can be worked on independently at the same time to greatly increase the speed at which the platform is constructed with the following sections being made by differing groups of students overseen by the project lead:

* Construction of the following sections
  + Hands
  + Arms
  + Head
  + Torso
* Development of the computer systems and electronics to control the robot
* Software development to allow for programming and other control methods

The use of ‘MyRobotLab’ will allow a simulation of the intended platform to be used in development of the software independent of both a full robot and the computer systems that is intended to be used.

There are potential bottlenecks with using this modular approach mainly with the manufacturing and sourcing of parts. This may require that sections that will take longer to construct or require more parts take priority in manufacturing as to ensure the continuation of the project.

As outlined in the original design 3D printers will be required analysis into the available machines and their suitability will need to be conducted along with the sourcing of parts as outlined in the BOM.